

**GEOTECHNICAL INVESTIGATION
MINNETEX AREA AND ALMEDA
GENOA PLACE DRAINAGE AND
PAVING IMPROVEMENTS
WBS NO. M-000289-0002-3
HOUSTON, TEXAS
REPORT NO. 1140195801**

Reported to:

KIT PROFESSIONALS, INC.

Houston, Texas

Submitted by:

GEOTEST ENGINEERING, INC.

Houston, Texas

April 30, 2014

Key Map Nos. 574 N



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April 30, 2014

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**Reference: Geotechnical Investigation
Minnetex Area and Almeda Genoa Place
Drainage and Paving Improvements
WBS No. M-000289-0002-3
Houston, Texas**

Dear Mr. Punukula:

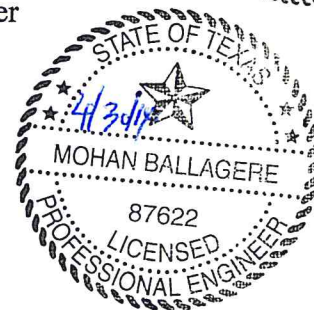
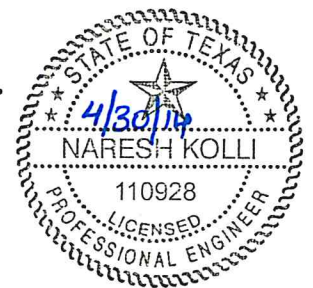
Presented herein is our final geotechnical investigation report for the Minnetex Area and Almeda Genoa Place Drainage and Paving Improvements Project. A draft report was submitted to you on October 14, 2013. This final report supersedes all previously submitted reports, transmittals, etc. for the referenced project. This study was authorized by Notice to Proceed email dated July 11, 2013 by accepting our proposal No. 1140333299 dated May 16, 2013.

We appreciate this opportunity to be of service to you. If you have any questions regarding the report, or if we can be of further service to you, please call us.

Sincerely,
GEOTEST ENGINEERING, INC.
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EXECUTIVE SUMMARY

A geotechnical investigation was performed for the design and construction of the proposed Minnetex Area and Almeda Genoa Place Drainage and Paving Improvements project in Houston, Texas. The project is comprised of approximately 11,730 LF of pavement reconstruction (with rigid pavement) and the utilities replacement along several streets in the Minnetex Area and Almeda Genoa Place. The utilities include storm sewer, water line and sanitary sewer with proposed sizes ranging from 6 inches to 48 inches and utilities depths ranges from 4 to 23 feet. The proposed construction is by open cut method.

The purposes of this study were to evaluate soil and groundwater conditions and to provide geotechnical recommendations for the proposed drainage and Paving Improvements for Minnetex Area and Almeda Genoa Place. The investigation included drilling and sampling twenty one (21) borings each to depths ranging from 20 to 32 feet, installing piezometers in four (4) existing borings, performing laboratory tests on soil samples recovered from the borings, performing engineering analyses and developing geotechnical recommendations and preparing a geotechnical report.

The principal findings and conclusions developed from this investigation are as follows:

- The subsurface soil beneath pavement as encountered in borings GB-1 through GB-21 along various streets in the Minnetex Area and Almeda Genoa Place area consists of predominantly cohesive soils to the explored depths of 20 to 32 feet except in borings GB-1, GB-2, GB-6 and GB-21. In borings GB-1, GB-2, GB-6 and GB-21 the subsurface soil beneath pavement consists of cohesive with intermittent cohesionless soils or cohesive soils underlain by cohesionless soils to the explored boring depths of 20 to 32 feet. The cohesive soils consist of medium stiff to hard dark gray, gray, brown, yellowish brown and reddish brown sandy lean clay, lean clay with sand, lean clay, fat clay with sand and fat clay. The cohesionless soil consists of loose to medium dense brown and gray silty sand and sandy silt. Fill material consists of medium stiff to stiff dark gray and reddish brown fat clay with sand, shell fragments and wood was encountered between the depths of 0 to 20 feet in boring GB-15.

- Based on the available information from U.S. Geological Survey (USGS) Maps and information contained in house relating to geologic faults for the project area, the project area lies in the Mykawa Salt Dome. The Mykawa Salt Dome is associated with several surface and subsurface faults. Based on the review of the maps the nearest unnamed fault is about 500 feet northeast from the east end (Hendricksen Road) of the project area. However, based on the fact that several unknown faults were associated with the Mykawa Salt dome near the project area, to identify any fault crossings, a Phase I Geological fault study is recommended for the project.
- Groundwater was encountered in borings GB-1, GB-2, GB-4, GB-9, GB-10, GB-11, GB-12, GB-13, GB-15, GB-16, GB-17, GB-20 and GB-21 to depths ranging from 15.0 to 28.0 feet during drilling. The groundwater level, measured 15 to 20 minutes after water was first encountered, ranged from 10.4 to 21.6 feet in these borings. No groundwater was encountered in all the other borings drilled for this study. In piezometer borings GB-1P, GB-10P, GB-12P and GB-17P, the water level measured at 30 days ranges from 10.8 to 17.3 feet.
- The existing paving as obtained in the soil borings GB-1 through GB-21 consists of 3.0 to 16.0 inches of asphalt over 0 to 12.0 inches of shell, sand and shell base except in boring GB-18. Boring GB-18 was drilled in the grass area.
- All excavation operations for utilities should be carried out in accordance with OSHA standards and the City of Houston Standard Specifications. The backfill for utilities should be designed and constructed in accordance with City of Houston Standard Specification No. 02317.

The recommended pavement section for the various streets in the project area is given below:

Streets	Pavement Section
Lincolnshire Road, Glengarry Road, Allison Road, Hendricksen Road, Cottingham Road and Lea Road	7" Reinforced Concrete over 6" Lime Stabilized Subgrade

The details of pavement section are provided in Section 5.4 of this report.

1.0 INTRODUCTION

1.1 General

The City of Houston selected KIT Professionals to perform engineering services for the design and construction of Minnetex Area and Almeda Genoa Place Drainage and Paving Improvements Project in Houston, Texas. KIT Professionals, Inc. retained Geotest Engineering, Inc. as a part of the design team to perform geotechnical investigation for the above project.

1.2 Authorization

This study was authorized by Notice to Proceed email dated July 11, 2013 by accepting our proposal No. 1140333299 dated May 16, 2013.

1.3 Location and Description of Project

The project is located in Minnetex Area and Almeda Genoa Place in Houston, Texas. The project area is bounded by Almeda Genoa Road to the north, Hendricksen Road to the east, Allison Road to the south and Pembroke Drive to the west, within the Key Map Page and Grid 574 N.

The project is comprised of approximately 11,730 LF of pavement reconstruction (with rigid pavement) and the utilities replacement along several streets in the Minnetex Area and Almeda Genoa Place. The utilities include storm sewer, water line and sanitary sewer with proposed sizes ranging from 6 inches to 12 inches of water line, 8 inches to 36 inches of sanitary sewer and 24 inches to 48 inches of storm sewer. The depth of the storm sewer ranges from approximately 6 feet to 23 feet and the depth of the sanitary sewer ranges from approximately 8 feet to 18 feet. The water line depth is about 4 to 5 feet. The proposed construction is by open cut method. The vicinity map of the project area is shown on Figure 1.

1.4 Purpose and Scope

The purposes of this study were to evaluate soil and groundwater conditions and to provide geotechnical recommendations for the design and construction of the proposed drainage and paving improvements in the Minnetex Area and Almeda Genoa Place. The scope of this investigation for consisted of the following:

- Drilling and sampling twenty one (21) borings to depths ranging from 20 to 32 feet.
- Converting four (4) borings into piezometers to monitor long term ground water level.
- Performing appropriate laboratory tests in accordance with ASTM methods on selected samples to develop engineering properties of the soil.
- Reviewing available fault information to evaluate the potential for known active faults that may impact the project.
- Performing engineering analyses in accordance with the City of Houston Design Manual (July 2012) to develop geotechnical recommendations for the design and construction of the proposed drainage and paving improvements in Minnetex Area and Almeda Genoa Place project area.
- Preparing a geotechnical report that will include all field data, laboratory test data and geotechnical recommendations.
- Preparing a separate soil type report for trench (open cut) excavation.

2.0 FIELD INVESTIGATION

2.1 General

After obtaining the utilities clearance of proposed twenty one (21) marked borings in the field, the borings were drilled to the explored depths utilizing a truck mounted drilling rig. Traffic control devices and personnel were utilized during coring and drilling to maintain safety of drill crew and people driving in the streets. All the drilling and sampling were performed in accordance with appropriate ASTM procedures.

2.2 Geotechnical Borings

Subsurface conditions for the project area were explored by drilling and sampling twenty one (21) soil borings (designated as GB-1 through GB-21) each to depths ranging from 20 to 32 feet. The approximate boring locations are shown on Figures 2.1 and 2.2, Plan of Borings. Survey information (Northing and Easting coordinates and ground surface elevation) of completed borings was provided to us by KIT Professionals, Inc. The survey information of completed borings is summarized in Table 1.

In general, samples were obtained continuously to the depth of 20 feet, and intermittent sampling at 5 foot intervals to the termination depths 20 to 32 feet for all borings. Cohesive soils were obtained with a 3-inch thin-walled tube sampler in general accordance with ASTM Method D 1587 and samples of granular soils were obtained with a 2-inch diameter split-barrel sampler in general accordance with ASTM Method D 1586. Each sample was removed from the sampler in the field, carefully examined and then logged by an experienced soils technician. Suitable portions of each sample were sealed and packaged for transportation to Geotest's Laboratory. The shear strength of cohesive soil samples was estimated using a pocket penetrometer in the field. Driving resistances for the split-barrel sampler were recorded as "Blows per Foot" on the boring logs. All the borings, except the ones converted to piezometers, were grouted with cement-bentonite grout after completion of drilling and obtaining water level measurements.

Detailed descriptions of the soils encountered in the borings are given on the boring logs presented on Figures A-1 through A-21 in Appendix A. A key to symbols and terms used on boring logs is given on Figure A-22 in Appendix A.

2.3 Piezometer Installation

During the field investigation, piezometers were installed in the open borehole of borings GB-1, GB-10, GB-12 and GB-17. The location of the piezometers, designated as GB-1P, GB-10P, GB-12P and GB-17P, are shown on Figures 2.1 and 2.2 (Plan of Borings). The piezometer installation report showing the details of the construction of the piezometers are provided on Figures A-23 through A-26 in Appendix A.

The piezometers were abandoned in place after taking the final water level measurements. The piezometer abandonment reports were presented in Appendix C.

3.0 LABORATORY TESTING

The laboratory testing program was designed to evaluate the pertinent physical properties and shear strength characteristics of the subsurface soils. Classification tests were performed on selected samples to aid in soil classification. All the tests were performed in accordance with ASTM Standards.

Undrained shear strengths of selected cohesive samples were measured by unconsolidated undrained (UU) triaxial compression tests (ASTM D 2850). The results of the UU triaxial compression tests are plotted on the boring logs as solid squares. The shear strength of cohesive samples was measured in the field with a calibrated hand pocket penetrometer and also in the laboratory with a Torvane. The shear strength values obtained from the penetrometer and Torvane are plotted on the boring logs as open circles and triangles, respectively.

Measurements of moisture content and dry unit weight were taken for each UU triaxial compression test sample. Moisture content (ASTM D 2216) measurements were also made on other samples to define the moisture profile at each boring location. The liquid and plastic limit tests (ASTM D 4318) and percent passing No. 200 sieves (ASTM D 1140) were performed on appropriate samples. Sieve analysis (ASTM D 422) was also performed on selected cohesionless soil sample.

The result of all tests are tabulated or summarized on the boring logs presented on Figures A-1 through A-21 in Appendix A. The summary of laboratory tests is also presented in a tabular form on Figures B-1 through B-21 in Appendix B. The grain size distribution curves are presented on Figure B-22 in Appendix B.

4.0 SUBSURFACE CONDITIONS

4.1 Geology

The project area lies in the Beaumont Formation. The clays and sands of the Beaumont Formation are over-consolidated as a result of desiccation from frequent rising and lowering of the sea level and the groundwater table. Consequently, clays of this formation have moderate to high shear strength and relatively low compressibility. The sands of the Beaumont Formation are typically very fine and often silty. Further, there is occasional evidence in the Houston area of the occurrence of cemented material (sandstone and siltstone) deposits within the Beaumont Formation.

4.2 General Fault Information

A review of information in the Geotest library, relating to known surface and subsurface geologic faults in the general area of the project alignments, was undertaken. The available information consisted of U.S. Geological and NASA maps, open file reports and information contained in our files relating to geologic faults in the project area.

Based on the available information from U.S. Geological Survey (USGS) Maps and information contained in house relating to geologic faults for the project area, the project area lies in the Mykawa Salt Dome. The Mykawa Salt Dome is associated with several surface and subsurface faults. Based on the review of the maps the nearest unnamed fault is about 500 feet northeast from the east end (Hendricksen Road) of the project area. However, based on the fact that several unknown faults were associated with the Mykawa Salt dome near the project area, to identify any fault crossings, a Phase I Geological fault study is recommended for the project. The Phase I Geological Fault Study will be performed as a separate study and will be submitted under separate cover.

4.3 Existing Paving

The existing paving as obtained in the soil borings GB-1 through GB-21 consists of 3.0 to 16.0 inches of asphalt over 0 to 12.0 inches of shell, sand and shell base except in boring GB-18. Boring GB-18 was drilled in the grass area.

The details of the existing pavement thickness at each of the boring locations for Minnetex Area and Alameda Genoa Place Project area are summarized below:

Boring Nos.	Asphalt Thickness (in)	Base Thickness (in)	Total (in.)
GB-1 (GB-1P)	3.5	8.0	11.5
GB-2	8.0	4.0	12.0
GB-3	8.0	4.0	12.0
GB-4	8.0	4.0	12.0
GB-5A	6.0	8.0	14.0
GB-6	6.0	6.0	12.0
GB-7	8.0	4.0	12.0
GB-8	6.0	6.0	12.0
GB-9	6.0	6.0	12.0
GB-10 (GB-10P)	6.0	10.0	16.0
GB-11	4.0	7.0	11.0
GB-12 (GB-12P)	9.0	3.0	12.0
GB-13	3.0	6.0	9.0
GB-14	6.0	10.0	16.0
GB-15	6.0	12.0	18.0
GB-16	6.0	12.0	18.0
GB-17 (GB-17P)	6.0	12.0	18.0
GB-19	16.0		16.0
GB-20	16.0		16.0
GB-21	4.0	5.0	9.0

Note: The base includes shell, sand and shell.
Boring GB-18 was drilled in grass area.

4.4 Soils Stratigraphy

Based on the subsurface soils encountered in the boreholes, six (6) boring log profiles were developed and are presented on Figures 3.1 through 3.6. To the left of each boring shown on the profile is an indication of the consistency of each stratum. More than one consistency for an individual stratum indicates that the consistency is different at different depths within the stratum. For cohesive soils, consistency is related to the undrained shear strength of the soil. For cohesionless soils, the relative density of soil is measured by standard penetration test blows of the soil. To the right of each boring shown on the profile is the overall classification of the soil contained within each stratum. The symbols and abbreviations used on the boring log profile are given on Figure 4. The soil classification is based on ASTM Standards.

The subsurface soils beneath pavement as encountered in borings GB-1 through GB-21 and as shown in boring log profiles 3.1 through 3.6 along various streets in the Minnetex Area and Almeda Genoa Place area are summarized below:

Lincolnshire Road:

Boring No.	Location/Street	Boring Depth (ft)	Soil Description
GB-1 thru GB-5A and GB-16 (Boring Log Profile Figures 3.1)	Lincolnshire Road	0-25	Medium stiff to hard gray, brown, yellowish brown and reddish brown Fat Clay, Fat Clay with sand and Lean Clay w/sand. A stratum of loose brown Sandy Silt was encountered in boring GB-1 between depths of 16 and 23 feet and loose brown Silty Sand was encountered in borings. GB-2 between the depths of 14 and 17 feet.

The Fat Clay and Fat Clay with sand are of high to very high plasticity with a liquid limits ranging from 56 to 84 and a plasticity indices ranging from 34 to 54. The Lean Clay w/sand is of medium plasticity with a liquid limit of about 35 and a plasticity index of about 18. The percent fines (percent passing No. 200 sieve) of Fat Clay with sand and Fat Clay ranges from 83 to 100 percent. The percent fines of Sandy Silt is about 56 percent. The percent fines of Silty Sand is about 44 percent.

Glengarry Road:

Boring No.	Location/Street	Boring Depth (ft)	Soil Description
GB-6 through GB-10 and GB-15 (Boring Log Profile Figure 3.2)	Glengarry Road	0-25	Medium Stiff to hard gray, yellowish brown and reddish brown and gray Fat Clay with sand, Fat Clay and Sandy Lean Clay, Lean Clay with sand and Lean Clay. A layer of medium dense reddish brown Silty Sand was encountered in boring GB-6 between depths of 23.5 and 25 feet. Fill material consisting of medium stiff to stiff gray, dark gray lean clay w/sand, fat clay with shell, gravel and wood was encountered between depths of 0 and 20 feet in boring GB-15.

The Fat Clay and Fat Clay with sand is of high to very high plasticity with liquid limits ranging from 53 to 77 and plasticity indices ranging from 31 to 49. The Lean Clay and Lean Clay with sand are of medium plasticity with liquid limits ranging from 36 to 47 and a plasticity indices ranging from 19 to

30. The percent fines (percent passing No. 200 sieve) of Fat Clay and Fat Clay with sand ranges from 82 to 98 percent. The percent fines of Lean Clay is about 93 percent. The percent fines of Silty Sand is about 32 percent.

Allison Road:

Boring No.	Location/Street	Boring Depth (ft)	Soil Description
GB-11 through GB-14 and GB-19 (Boring Log Profile Figure 3.3)	Allison Road	0-30	Medium stiff to hard dark gray, gray, brown, yellowish brown and reddish brown Fat Clay with sand, Fat Clay, Lean Clay with sand and Lean Clay.

The Fat Clay with sand and Fat Clay is high to very high plasticity with liquid limit ranging from 51 to 82 and plasticity indices ranging from 30 to 53. The Sandy Lean Clay, Lean Clay with sand and Lean Clay is of medium plasticity with a liquid limit ranging from 39 to 40 and plasticity indices ranging from 23 to 24. The percent fines (percent passing No. 200 sieve) of Fat Clay with sand ranges from 75 to 78 percent. The percent fines of Lean Clay and Fat Clay ranges from 87 to 100 percent. The percent fines of Sandy Lean Clay is about 68 percent.

Cottingham Road:

Boring No.	Location/Street	Boring Depth (ft)	Soil Description
GB-14 through GB-17 (Boring Log Profile Figure 3.4)	Cottingham Road	0-31	Medium stiff to hard gray, brown, yellowish brown and reddish brown Fat Clay, Fat Clay with sand, Lean Clay and Lean Clay with sand. Fill material consisting of medium stiff to stiff dark gray, gray, and reddish brown Lean Clay w/sand and Fat Clay with sand, shell and wood was encountered between the depths of 0 to 20 feet in boring GB-15.

The Fat Clay and Fat Clay with sand is of high to very high plasticity with liquid limits ranging from 51 to 77 and plasticity indices ranging from 30 to 49. The Lean Clay and Lean Clay with sand is of medium to high plasticity with liquid limits ranging from 36 to 45 and plasticity indices ranging from 17 to 23. The percent fines of Fat Clay and Lean Clay ranges from 86 to 100. The percent fines of Fat Clay with sand and Lean Clay w/sand ranges from 75 to 82 percent.

Martin Luther King Drive:

Boring No.	Location/Street	Boring Depth (ft)	Soil Description
GB-18	Martin Luther King	0-32	Medium Stiff to hard dark gray, gray, brown and reddish brown Fat Clay, Fat Clay with sand and Sandy Lean Clay.

The Fat Clay and Fat Clay with sand is of high to very high plasticity with liquid limits ranging from 61 to 84 and plasticity indices ranging from 37 to 54. The percent fines (percent passing No. 200 sieve) of Fat Clay and Fat Clay w/sand ranges from 78 to 99 percent.

Hendricksen Road:

Boring No.	Location/Street	Boring Depth (ft)	Soil Description
GB-5A, GB-10, GB-19 and GB-20 (Boring Log Profile, Figures 3.5)	Hendricksen Road	0-25	Stiff to hard gray, brown, yellowish brown and reddish brown Fat Clay and Fat Clay w/sand.

The Fat Clay and Fat Clay w/sand is of high to very high plasticity with liquid limit ranging from 64 to 80 and plasticity indices ranging from 39 to 51. The percent fines (percent passing No. 200 sieve) of Fat Clay ranges from 92 to 100 percent. The percent fines of Fat Clay w/sand is about 83 percent.

Lea Road:

Boring No.	Location/Street	Boring Depth (ft)	Soil Description
GB-2, GB-7, GB-11 and GB-21 (Boring Log Profile Figure 3.6)	Lea Road	0-25	Medium stiff to very stiff gray and reddish brown Fat Clay, Fat Clay with sand, Lean Clay, Lean Clay with sand and Sandy Lean Clay. Loose to medium dense reddish brown Silty Sand was encountered in borings GB-2 and GB-21 between the depths of 14 to 17 and 16 to 18 feet, respectively.

The Fat Clay and Fat Clay with sand is of high to very high plasticity with liquid limits ranging from 52 to 66 and plasticity indices ranging from 31 to 43. The Lean clay, Lean Clay with sand and Sandy Lean Clay is of medium to high plasticity with liquid limits ranging from 39 to 47 and plasticity indices ranging from 23 to 30. The percent fines (percent passing No. 200 sieve) of Fat Clay and Lean

Clay ranges from 94 to 100 percent and the percent fines of Fat Clay with sand and Lean Clay with sand ranges from 78 to 85 percent. The percent fines of Sandy Lean Clay is about 59 percent. The percent fines of Silty Sand ranges from 43 to 44 percent.

4.5 Water Levels

Groundwater was encountered in borings GB-1, GB-2, GB-4, GB-9, GB-10, GB-11, GB-12, GB-13, GB-15, GB-16, GB-17, GB-20 and GB-21 to depths ranging from 15.0 to 28.0 feet during drilling. The groundwater level, measured 15 to 20 minutes after water was first encountered, ranged from 10.4 to 21.6 feet in these borings. No groundwater was encountered in all the other borings drilled for this study. In piezometer borings GB-1P, GB-10P, GB-12P and GB-17P, the water level measured at 30 days ranges from 10.8 to 17.3 feet.

Boring No.	Location/Street Name	Groundwater Depth During Drilling (ft)	Groundwater Depth 30 Days After Drilling (ft)
GB-1 (GB-1P)	Lincolnshire	12.0	11.3 (8-28-13)
GB-2	Lincolnshire	10.9	N/A
GB-4	Lincolnshire	20.6	N/A
GB-9	Glengarry	17.0	N/A
GB-10 (GB-10P)	Glengarry	Dry	10.8 (8-28-13)
GB-11	Allison	10.4	N/A
GB-12 (GB-12P)	Allison	Dry	17.3 (8-28-13)
GB-13	Allison	13.3	N/A
GB-15	Cottingham	17.2	N/A
GB-16	Cottingham	18.3	N/A
GB-17 (GB-17P)	Cottingham	16.8	15.8 (8-28-13)
GB-20	Hendricksen	21.0	N/A
GB-21	Lea	11.4	N/A

However, it should be noted that various environmental and man-made factors such as amount of precipitation, nearby subsurface construction activities, and change in area drainage can substantially influence the groundwater level.

4.6 Environmental Concerns

No environmental concerns were observed or noticed in any of the borings (GB-1 through GB-21) drilled for this study.

5.0 ENGINEERING ANALYSES AND RECOMMENDATIONS

5.1 General

The project is comprised of approximately 11,730 LF of pavement reconstruction (with rigid pavement) and the utilities replacement along several streets in the Minnetex Area and Almeda Genoa Place. The utilities include storm sewer, water line and sanitary sewer with proposed sizes ranging from 6 inches to 12 inches of water line, 8 inches to 36 inches of sanitary sewer and 24 inches to 48 inches of storm sewer. The depth of the storm sewer ranges from approximately 6 feet to 23 feet and the depth of the sanitary sewer ranges from approximately 8 feet to 18 feet. The water line depth is about 4 to 5 feet. The proposed construction is by open cut method.

5.2 Trench Excavation

Based on the information provided by KIT Professionals, Inc., it is understood that the water line, storm sewer and sanitary sewer will be installed by open cut method of construction. The following subsections provide information for the design and construction of the storm sewer and sanitary sewer open cut method of excavations.

5.2.1 Geotechnical Parameters. Based on the soil conditions revealed by the borings GB-1 through GB-21, geotechnical parameters were developed for the design of open cut construction for storm sewer and sanitary sewer installation. The design parameters are provided in Table 2. For design, the groundwater level should be assumed to exist at the ground surface.

5.2.2 Excavation Stability. The open excavation may be shored or laid back to a stable slope or supported by some other equivalent means used to provide safety for workers and adjacent structures, if any. The excavating operations should be in accordance with OSHA Standards, OSHA 2207, Subpart P, latest revision and the City of Houston Standard Specification.

- Excavation Shallower Than 5 Feet - Excavations that are less than 5 feet deep (**critical height**) should be effectively protected when an indication of dangerous ground movement is anticipated.

- Excavations Deeper Than 5 Feet - Excavations that are deeper than 5 feet should be sloped, shored, sheeted, braced or laid back to a stable slope or supported by some other equivalent means or protection such that workers are not exposed to moving ground or cave-ins. The slopes and shoring should be in accordance with the trench safety requirements as per OSHA Standards. The following items provide design criteria for excavation stability.
 - (i) OSHA Soil Type. Based on the soil conditions revealed by borings drilled for this study and assumed groundwater level at surface, OSHA soil type “C” should be used for determination of allowable maximum slope and/or the design of shoring along the alignment for full proposed depth of open excavation. For shoring deeper than 20 feet (if needed), an engineering evaluation is required and deeper soil borings will be needed.
 - (ii) Excavation Support Earth Pressure. Based on the subsurface conditions indicated by our field investigation and laboratory testing results, excavation support earth pressure diagram is developed and is presented on Figure 5. This pressure diagram can be used for the design of temporary trench bracing. For a trench box, a lateral earth pressure resulting from an equivalent fluid with a unit weight of 92 pcf can be used. The effects of any surcharge loads at the ground surface should be added to the computed lateral earth pressures. A surcharge load, q , will typically result in a lateral load equal to $0.5 q$. The above value of equivalent fluid pressure is based on assumption that the groundwater level is near the ground surface, since these conditions may exist after a heavy rain or flooding.
 - (iii) Bottom Stability. In braced cuts, if tight sheeting is terminated at the base of the cut, the bottom of the excavation can become unstable. The parameters that govern the stability of the excavation base are the soil shear strength and the differential hydrostatic head between the groundwater level within the retained soils and the groundwater level at the interior of the trench excavation. For cut in cohesive soils as

predominantly encountered for the proposed excavation depths (8 to 23 feet) in all the borings, the bottom stability can be evaluated as outlined on Figure 6.

5.2.3 Groundwater Control. Excavations for the water line, sanitary sewer and storm sewer may encounter groundwater seepage to varying degrees depending upon the groundwater conditions at the time of construction and the location and depth of the trench. Based on the soil conditions identified in the borings for the proposed water line, sanitary sewer and storm sewer installation, all the excavations (for excavation depths of 8 to 23 feet) will be in cohesive soils. In general for cohesive soils as encountered in all the borings for the excavation depths, the groundwater (if encountered) may be managed by collection in excavation bottom sumps for pumped disposal. It is recommended that the actual groundwater conditions should be verified by the contractor at the time of construction and that groundwater control should be performed in general accordance with the City of Houston Standard Specifications, Section 01578.

5.2.4 Bedding and Backfill for Storm Sewer and Sanitary Sewer. In general, excavation and backfill for utilities should be designed and constructed in accordance with the City of Houston Standard Specification No. 02317, Subsection 3.09 and 3.10 "Excavation and Backfill for Utilities."

Bedding and backfill for storm sewer and sanitary sewer should be in accordance with City of Houston Standard Specification Section 02312 and Drawing No. 02317-03.

5.3 Structures

5.3.1 Description. The structure associated with this project will be new manholes. The new manholes for storm sewer will be placed at depths ranging from 8 to 23 feet, while the new manholes for sanitary sewer will be placed at depths ranging from 8 to 18 feet.

5.3.2 Foundation Conditions. Based on the soil conditions revealed by the borings GB-1 through GB-21, the manholes bottom will be in medium stiff to very stiff, fat clay, fat clay with sand, lean clay, lean clay with sand and sandy lean clay.

5.3.3 Foundation Design Recommendations. The following items provide recommendations and design criteria for construction of the new manholes.

- Allowable Bearing Pressures. The mat foundation for supporting the new manholes placed at depths ranging from 8 to 23 feet [into medium stiff to very stiff fat clay, fat clay with sand, lean clay and sandy lean clay] should be designed for an allowable (net) bearing pressure of 2,500 psf (for manholes placed between 8 and 23 feet) for total loads. These allowable bearing pressures include a safety factor of 2.0. The above recommendations assume that the final bearing surfaces consist of undisturbed natural soils and that underlying semi-transmissive zones are properly pressure-relieved and stable undisturbed bearing surfaces are attained.
- Bottom Stability. In braced cut, if sheeting is terminated at the base of the cut, the bottom of the excavation can become unstable under a certain condition. This condition is governed by the shear strength of the soils and by the differential hydrostatic head. For cuts in cohesive soils (sandy lean clay, lean clay w/sand and fat clay, fat clay with sand), as predominantly encountered in the excavation depths of 8 and 23 feet for all of the borings, the stability of the bottom can be evaluated in accordance with the procedure outlined in Figure 6.
- Lateral Earth Pressure. The pressure diagram presented on Figure 5 can be used for the design of braced excavation. The lateral earth pressure diagram presented on Figure 7 is applicable for the design of the permanent walls.
- Hydrostatic Uplift Resistance. Structures extending below the groundwater level should be designed to resist uplift pressure resulting from excess piezometric head. Design uplift pressures should be computed based on the assumption that the water table is at ground surface. To resist the hydrostatic uplift at the bottom of the structure, one of the following sources of resistance can be utilized in each of the designs.
 - a. Dead weight of structure,
 - b. Weight of soil above base extensions plus weight of structure, or

- c. Soil-wall friction plus dead weight of structure.

The uplift force and resistance to uplift should be computed as detailed on Figure 8. In determining the configuration and dimensions of the structure using one of the approaches presented on Figure 8, the following factors of safety are recommended.

- a. Dead weight of concrete structure, $S_{f1} = 1.10$,
- b. Weight of soil (backfill) above base extension, $S_{f2} = 1.5$, and
- c. Soil-wall friction, $S_{f3} = 3.0$.

Friction resistance should be discounted for the upper 5 feet, since this zone is affected by seasonal moisture changes.

5.3.4 Protection of Below Grade Structures. The design of the proper means for protection of below grade structures will depend upon the potential of the aggressivity or corrosivity of soil and groundwater properties. The aggressivity testing was not within the scope of this study. The design of the protection of below grade structures is beyond the scope of services for this study.

5.3.5 Groundwater Control During Construction. Excavations may encounter groundwater seepage to varying degrees depending upon groundwater conditions at the time of construction and the location and depth of excavation. In cohesive soils, as predominantly encountered in all of the borings for the proposed excavation depths, the groundwater may be managed by collection in trench bottom sumps for pumped disposal.

The contractor should verify the groundwater level at the time of construction and should provide an adequate dewatering system, where required.

5.3.6 Structure Backfill. Excavations for the proposed structures should be backfilled in accordance with the City of Houston Standard Specifications, Section 02316, "Excavation and Backfill for Structures."

5.4 Pavement Structure Design

It is understood that approximately 11,730 linear feet of existing pavement at Minnetex Area and Almeda Genoa Place project area which includes minor streets (Lincolnshire, Glengarry, Allison, Cottingham, Hendricksen and Lea) will be reconstructed with a rigid pavement. The pavement design presented below was developed in accordance with “AASHTO Guide for Design of Pavement Structures,” 1993 Edition.

5.4.1 Design Parameters

Subgrade Soil Properties. Based on the laboratory test data obtained from the natural subgrade soils, the effective roadbed soil resilient modulus (M_R) is estimated to be about 1,941 psi. Based on an estimated resilient modulus of the 6-inch lime-stabilized subgrade, the effective modulus of subgrade reaction (k) is estimated to be about 46 pci.

Traffic Data. No traffic data is provided to us for the project alignments. Based on Houston Regional Traffic Counts Map, the traffic data is assumed for the streets in the project area. The details were given below.

A traffic data of 0.9×10^6 – 18 kips ESAL over a 20 year design period was utilized for the pavement design of all streets in the Minnetex Area and Almeda Genoa Place project area. **This traffic volume is based on assumed traffic of average daily traffic (ADT) volume of 1,500 vehicles for all the streets in the project area. A distribution of 96% passenger cars, 3.5% light trucks and 0.5% heavy trucks were assumed for all the streets in the project area.**

Other Design Parameters. Other design parameters used in the development of rigid pavement thickness are given below:

Material Properties of Concrete:

Modulus of Elasticity of Concrete (E_c): 4,100,000 psi

Mean value of Modulus of Rupture of Concrete after 28 days

(S'_c): 600 psi (based on compressive strength of 3,500 psi)

Load Transfer coefficient (J): 2.7

Drainage coefficient (C_d): 1.2

Overall Standard Deviation (S_o): 0.35

Reliability Level (R): 95%

Serviceability Index

Initial (P_o): 4.5

Terminal (P_t): 2.25

Reinforcement Variables

Allowable Working Stress (f_s): 45,000 psi (grade 60 steel)

Friction Factor (F): 1.8

5.4.2 Recommended Pavement Section

Based on the design parameters described above and the AASHTO design procedures, the thickness of rigid pavement was determined. The recommended pavement section is given below:

<u>Pavement, Course</u>	<u>Thickness, inches</u>
Reinforced Concrete	7
6% Lime-stabilized subgrade	6

Based on the reinforcement variables and recommended pavement section, the required longitudinal and transverse reinforcing steel (No. 4, Grade 60 Steel) can be determined for 7-inch concrete pavement per Table 1 of City of Houston Drawing No. 02751-01 (Revised July 1, 2009).

5.4.3 Preparation of Pavement Subgrade

Based on the field and laboratory test data, the subgrade soils at the finished grade of the project site consists of high to very high plasticity fat clay and medium plasticity lean clay w/sand

and sandy lean clay. These soils have medium to high volume change potential. Hence, lime stabilization of the clay subgrade will be required to reduce the swell potential of clay subgrade due to volume changes and to accelerate the construction and provide a stable subgrade on which to construct the pavement section. The subgrade soils should be stabilized with approximately 6 percent lime to a depth of at least 6 inches. This corresponds to approximately 28 pounds of hydrated lime per square yard based upon a soil dry unit weight of 103 pcf. It should be noted that quantity of lime was calculated based on the dry unit weight determined from the specific boring locations only.

Subgrade preparation for the proposed pavement after removing the existing pavement should consist of stripping, proof-rolling, and stabilization. The following procedures for subgrade preparation are recommended:

1. Strip the surficial soils to a suitable depth to remove all surficial vegetation and achieve grade. In isolated areas where soft, compressible, or very loose soils are encountered, additional stripping may be required. Stripping should extend to a minimum of 2 feet in the adjacent open (unpaved) area, where it exists beyond the edge of the proposed pavement.
2. After stripping, the exposed surface should be proof-rolled with a minimum of 3 passes of a 30-ton pneumatic-tired roller or a partially loaded truck utilizing a tire pressure of approximately 90 psi. If rutting develops, the tire pressure should be reduced. The purpose of the proof-rolling operation is to identify any underlying zones or pockets of soft soils so these weak materials can be removed and replaced.
3. Lime stabilization of cohesive subgrade should be performed in accordance with City of Houston Standard Specification No. 02336, "Lime-Stabilized Subgrade."

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Groundwater Control

Excavations for the water line, sanitary sewer and storm sewer may encounter groundwater seepage to varying degrees depending upon the groundwater conditions at the time of construction and the location and depth of the trench. Based on the soil conditions identified in the borings for the proposed sanitary sewer and storm sewer installation, all the excavations will be in cohesive soils. In general for cohesive soils as encountered in all the borings (for the excavation depths), the groundwater (if encountered) may be managed by collection in excavation bottom sumps for pumped disposal. It is recommended that the actual groundwater conditions should be verified by the contractor at the time of construction and that groundwater control should be performed in general accordance with the City of Houston Standard Specifications, Section 01578.

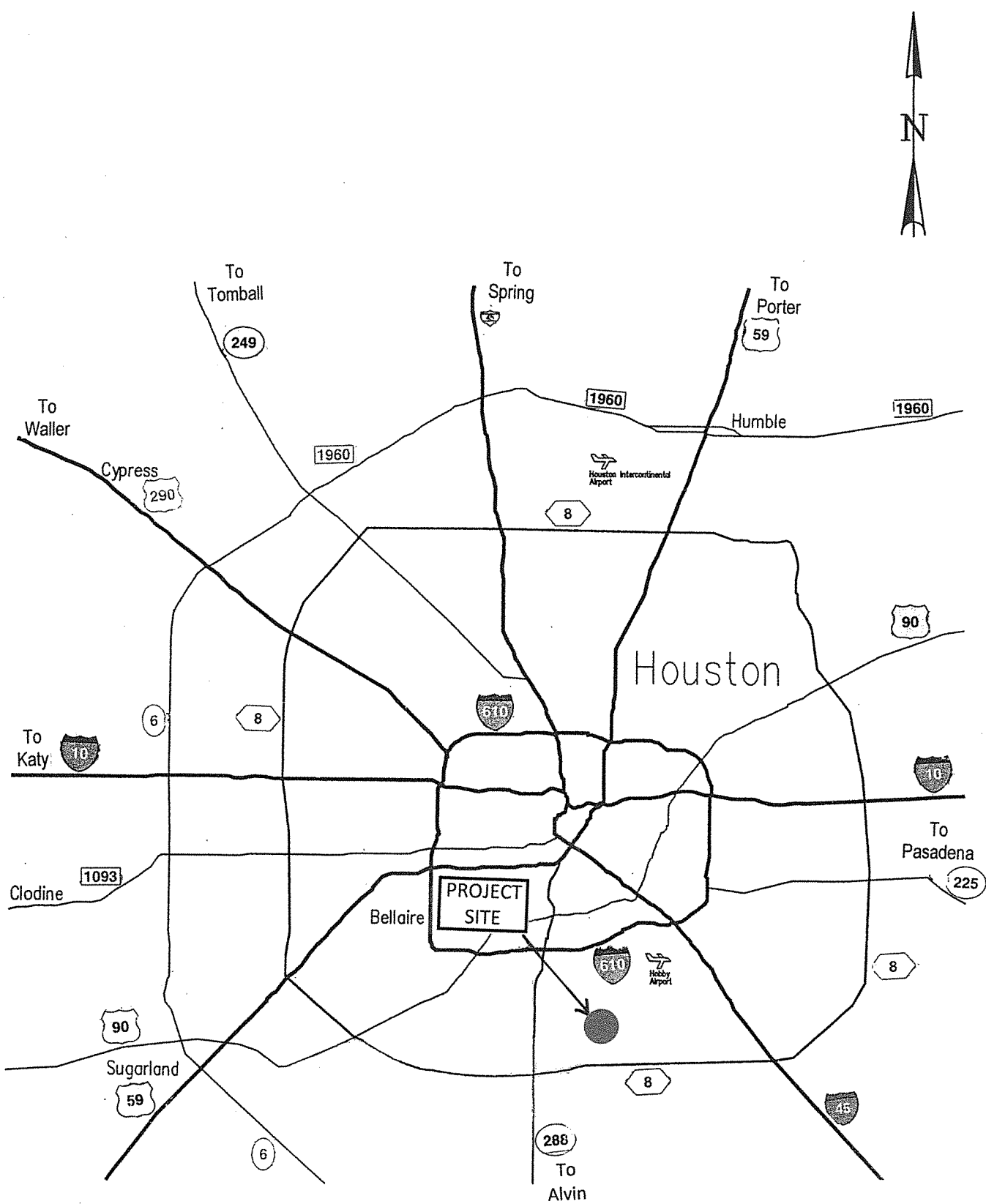
7.0 LIMITATIONS

The description of subsurface conditions and the design information contained in this report are based on the soil borings made at the time of drilling at specific locations. However, some variation in soil conditions may occur between soil borings. Should any subsurface conditions other than those described in our boring logs be encountered, Geotest should be immediately notified so that further investigation and supplemental recommendations can be provided. The depth of the groundwater level may vary with changes in environmental conditions such as frequency and magnitude of rainfall. The stratification lines on the log of borings represent the approximate boundaries between soil types, however, the transition between soil types may be more gradual than depicted.

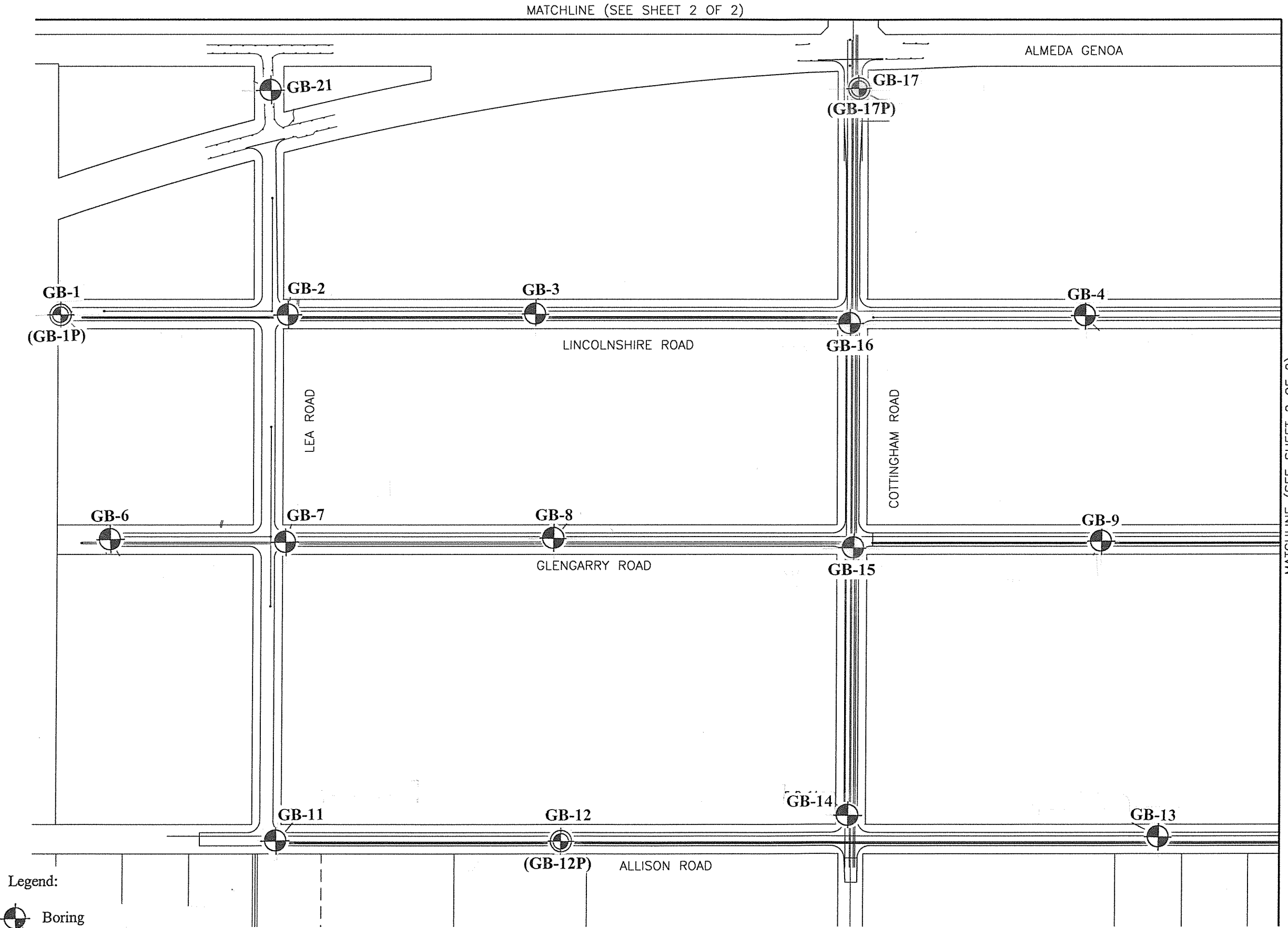
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ILLUSTRATIONS

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Boring Log Profile	3.1 thru 3.6
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Stability of Bottom for Braced Cut.....	6
Lateral Earth Pressure Diagram for Permanent Wall.....	7
Uplift Pressure and Resistance	8



VICINITY MAP
(NOT TO SCALE)



MATCHLINE (SEE SHEET 2 OF 2)

PRIVATE UTILITY LINES SHOWN
AT LEAST 48 HOURS BEFORE EXCAVATING IN STREET ROW OR EASEMENTS, CALL THE LONE STAR NOTIFICATION 713.223.4567

Date:

CenterPoint Energy/Electric Facilities
Signatures indicates underground electric lines are properly shown. No approval for construction is given.

Date:

Approval for AT&T Texas/SBC underground conduit facilities only.
Signature valid for one year.

Date:

Centerpoint Energy/Gas Facilities/ENTEX Incorporated
(Gas service lines are not shown)

KIT Professionals, Inc.
Engineers • Planners • Construction Managers
2825 Wilcrest Drive, Suite 600, Houston, Texas 77042
Phone: (713) 783-8700; Fax: (713) 783-8747
TBPE Firm Registration No. F-4991

AMANI ENGINEERING, INC.
8313 SOUTHWEST FREEWAY SUITE 350 HOUSTON, TX. 77074
Tel (713) 270-5700 Fax (713) 271-3487 TBPE REG NO: F-4528

THESE PLANS ARE PRELIMINARY AND ARE BEING ISSUED FOR REVIEW BY PUBLIC AGENCIES AND OTHER PRELIMINARY PURPOSES. WHEN ISSUED IN FINAL FORM

BY THE RESPONSIBLE ENGINEER.
KIT Professionals, Inc.
KEITH R. DAVIS, P.E.
TEXAS REGISTRATION NO.: 82625

SURVEYED BY:
F.B. No.:

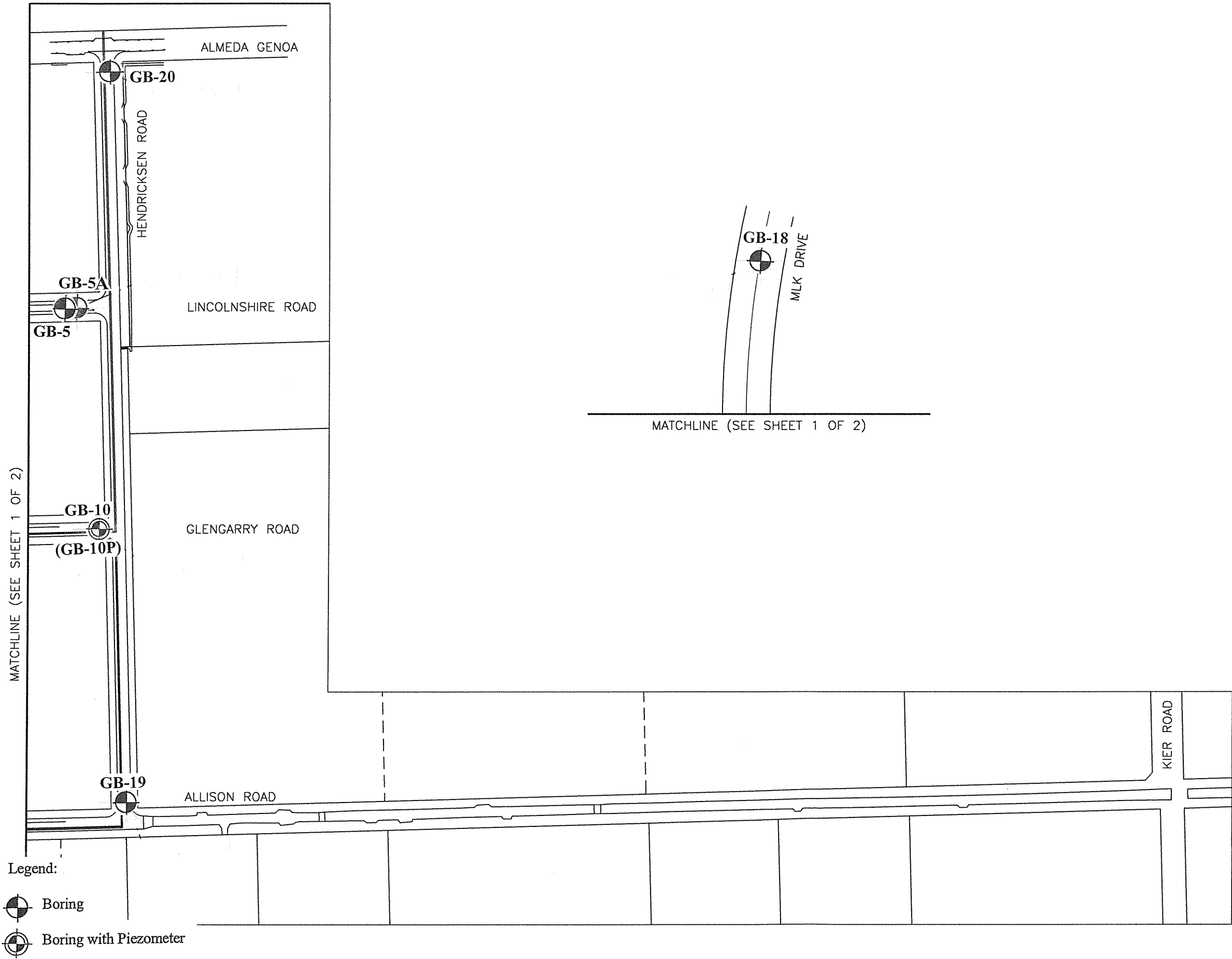
CITY OF HOUSTON
DEPARTMENT OF PUBLIC WORKS AND ENGINEERING

MINNETEX AREA AND ALAMEDA GENOA PLACE DRAINAGE AND PAVING IMPROVEMENTS

PLAN OF BORINGS

WBS NUMBER	
M-000289-0002-3	
DRAWING SCALE	
1" = 200'	
CITY OF HOUSTON PM	
JASON VO	
SHEET No. OF	

FIGURE 2.1



PRIVATE UTILITY LINES SHOWN
AT LEAST 48 HOURS BEFORE EXCAVATING IN STREET ROW OR EASEMENTS, CALL THE LONE STAR NOTIFICATION 713.223.4567

Date:

CenterPoint Energy/Electric Facilities
Signatures indicates underground electric lines are properly shown. No approval for construction is given.

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Approval for AT&T Texas/SBC underground conduit facilities only.
Signature valid for one year.

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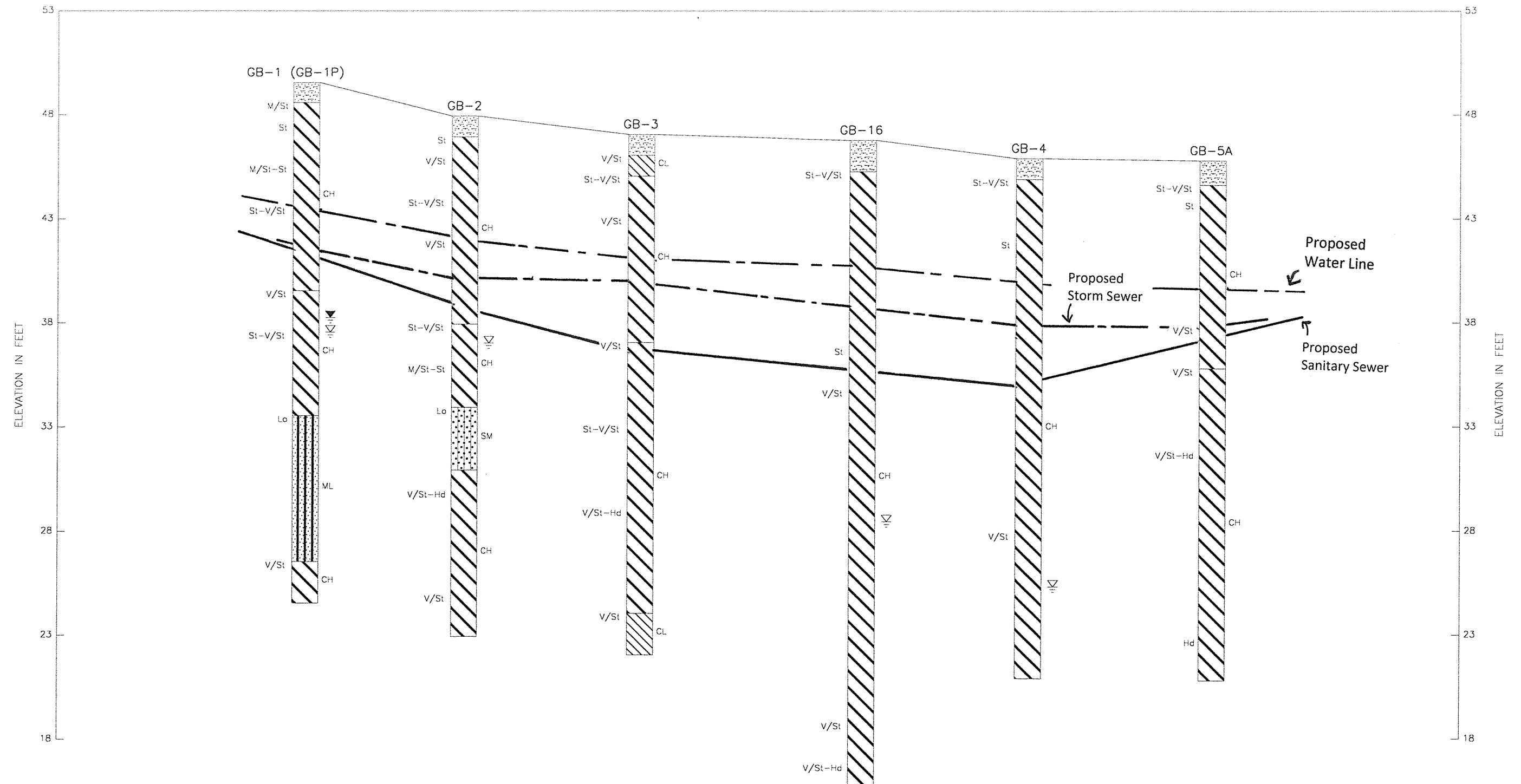
CITY OF HOUSTON
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MINNETEX AREA AND ALMEDA GENOA PLACE DRAINAGE AND PAVING IMPROVEMENTS

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WBS NUMBER	
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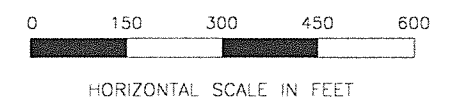
FIGURE 2.2

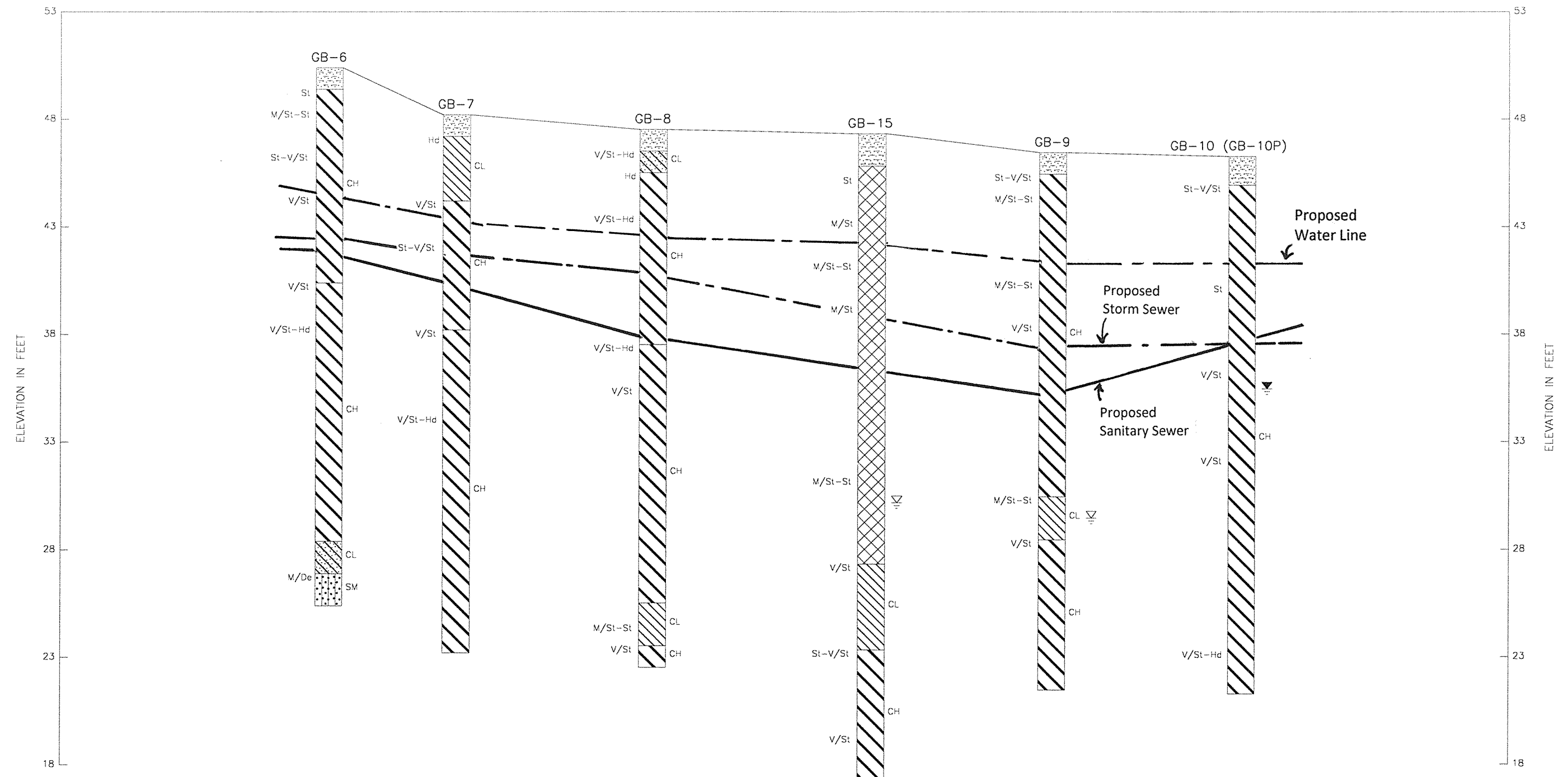


GENERAL NOTES:

1. See Figures 2.1 & 2.2 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by KIT Professionals, Inc.

BORING LOG PROFILE
LINCOLNSHIRE ROAD

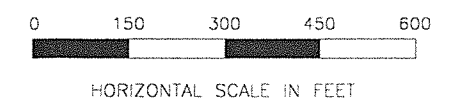


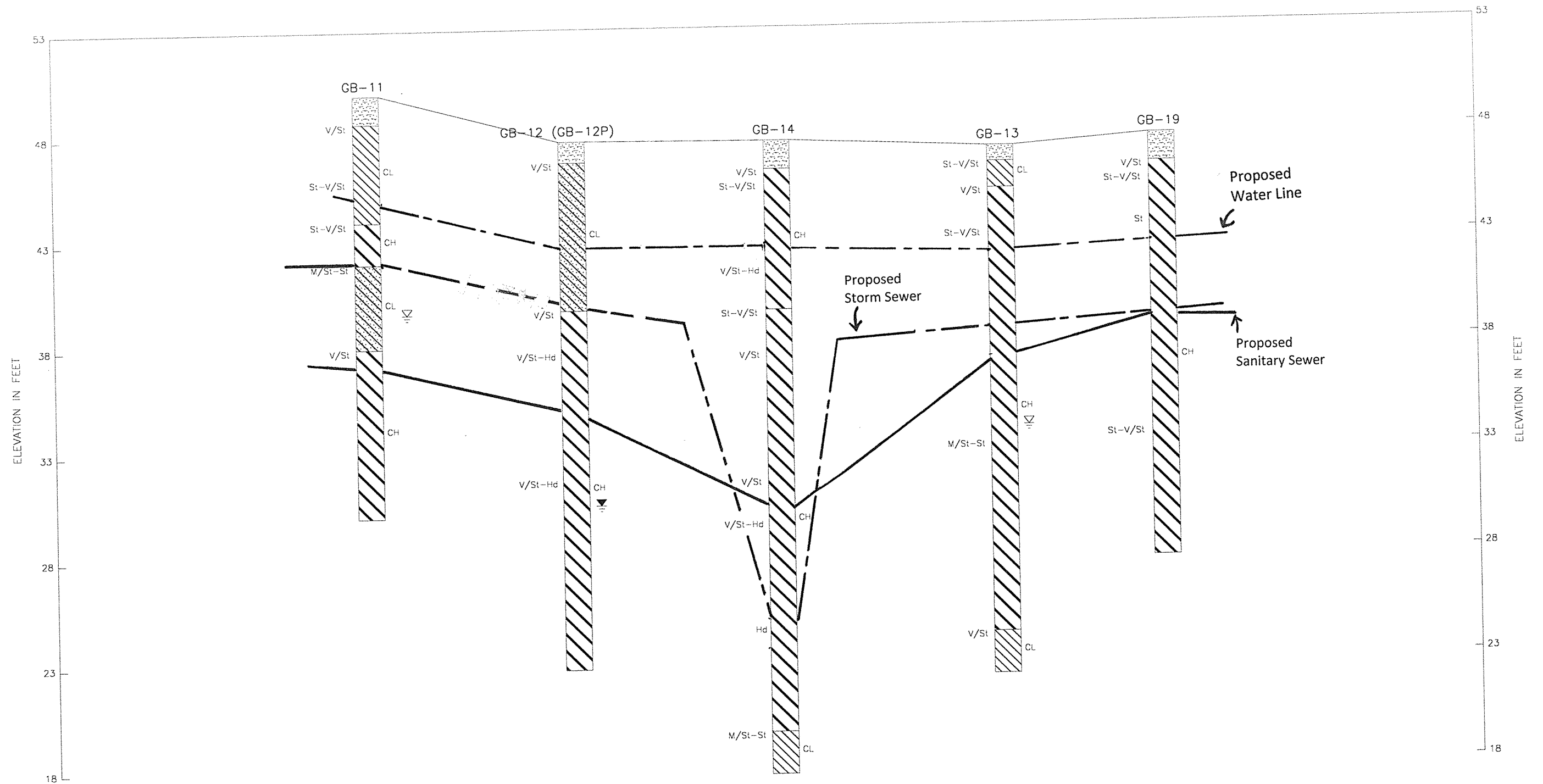


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BORING LOG PROFILE
GLENGARRY ROAD

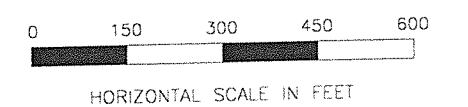


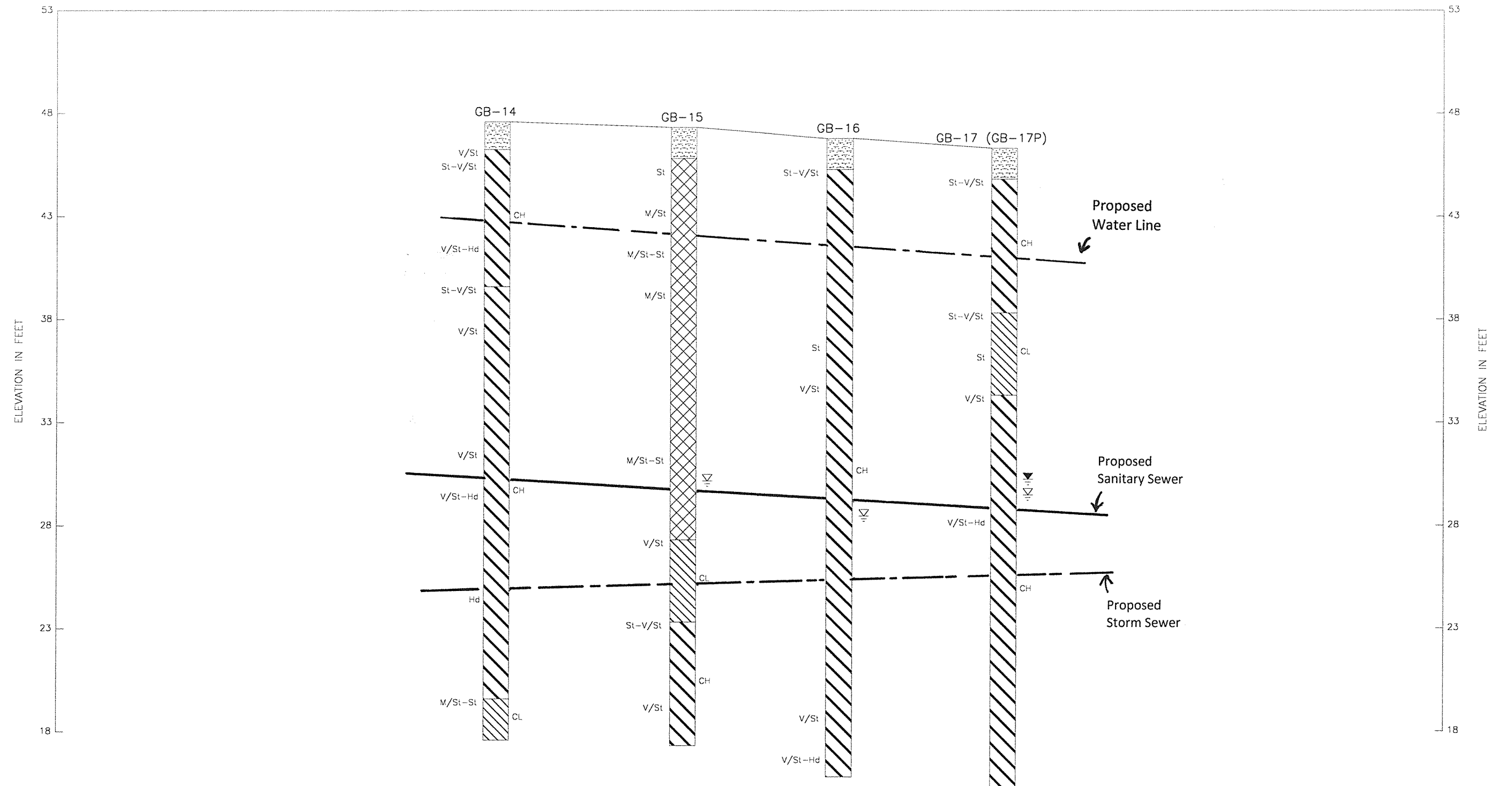


GENERAL NOTES:

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3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by KIT Professionals, Inc.

BORING LOG PROFILE
ALLISON ROAD

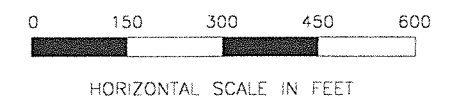


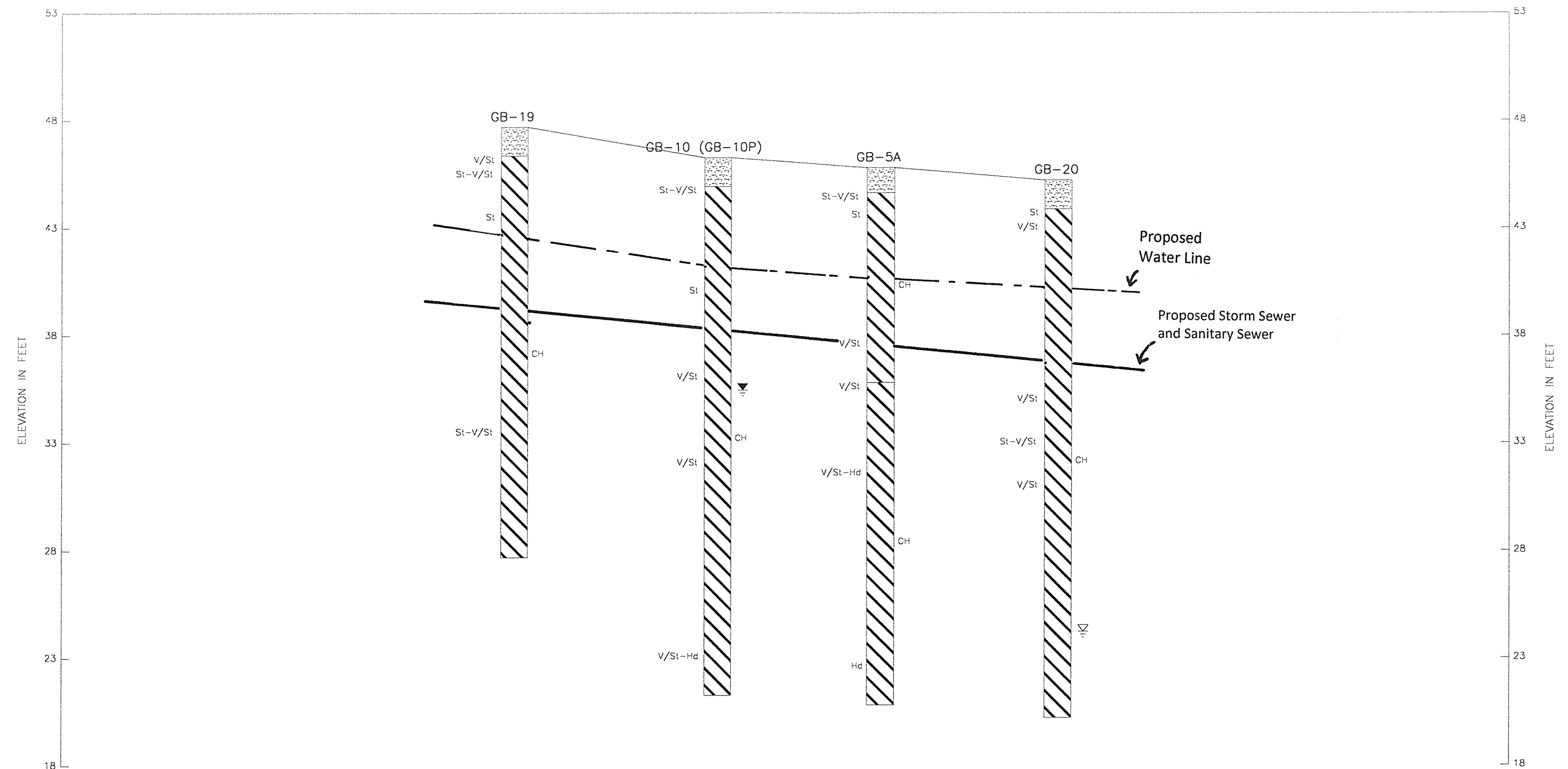


GENERAL NOTES:

1. See Figure 2.1 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by KIT Professionals, Inc.

BORING LOG PROFILE COTTINGHAM ROAD

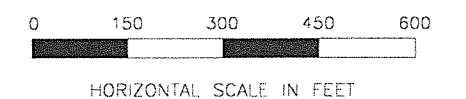


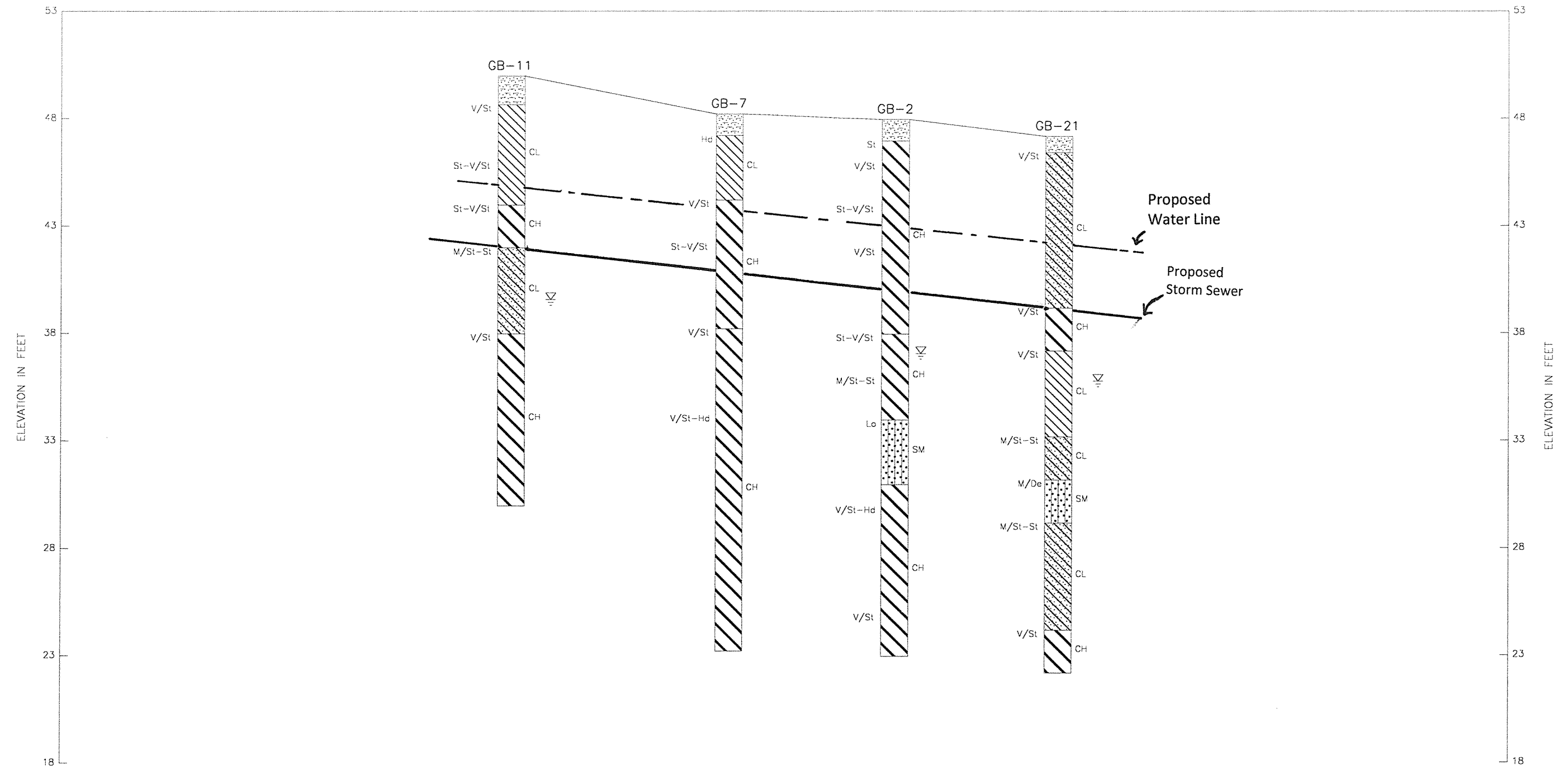


GENERAL NOTES:

1. See Figure 2.2 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
4. See Figure 4 for symbols and abbreviations used on this profile.
5. Ground surface elevation at each boring location was based on survey data provided to us by KIT Professionals, Inc.

BORING LOG PROFILE
HENDRICKSEN ROAD

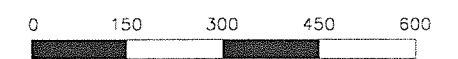




GENERAL NOTES:

1. See Figure 2.1 for approximate location of borings and profile section.
2. Data concerning subsurface conditions have been obtained at boring locations only. Actual conditions between borings may differ from the profile shown here.
3. See logs of boring for detailed description of soils encountered in each borehole.
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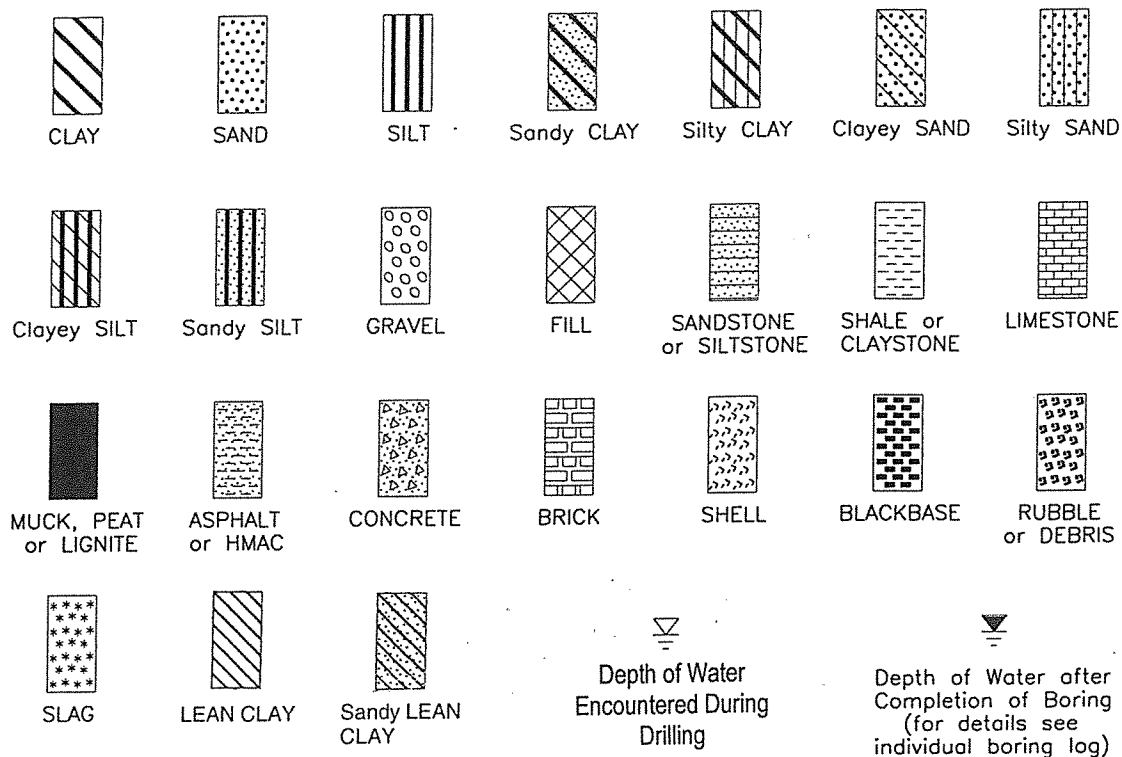
BORING LOG PROFILE
LEA ROAD



HORIZONTAL SCALE IN FEET

SYMBOLS AND ABBREVIATIONS USED ON BORING LOG PROFILE

LEGEND



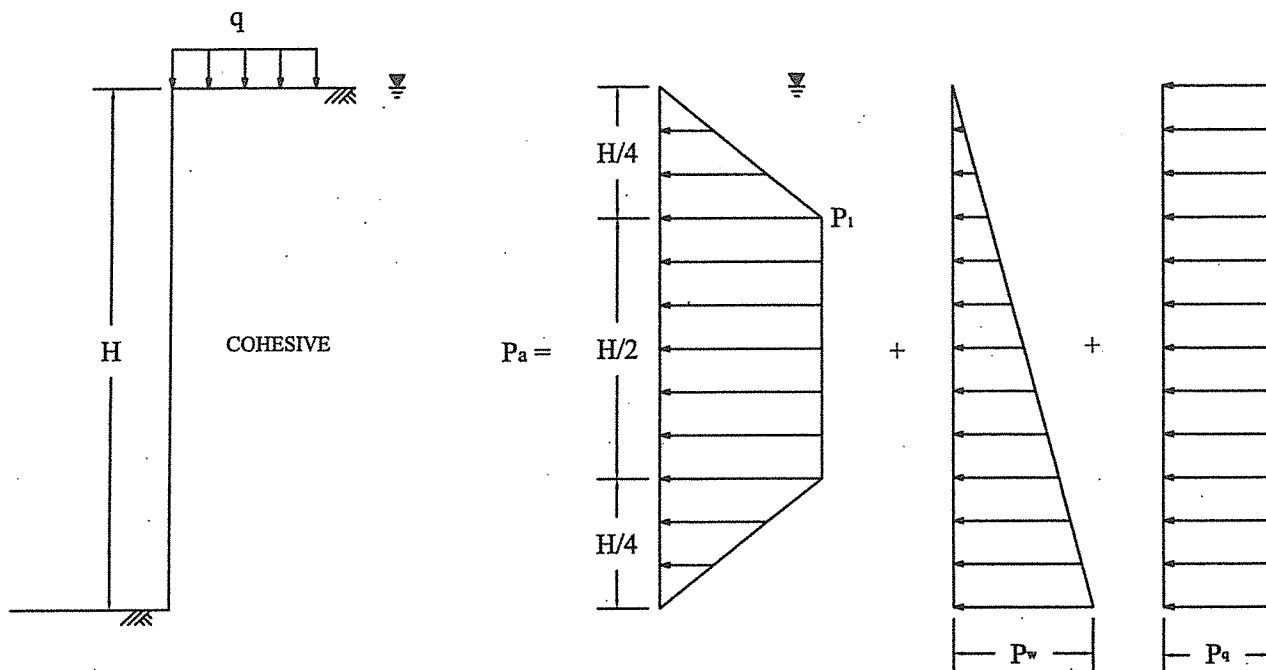
ABBREVIATIONS USED FOR CONSISTENCY/DENSITY

COHESIVE SOILS

V/So : Very Soft
 So : Soft
 Fm : Firm
 M/St : Medium Stiff
 St : Stiff
 V/St : Very Stiff
 Hd : Hard
 V/Hd : Very Hard

COHESIONLESS SOILS

V/Lo : Very Loose
 Lo : Loose
 S/Co : Slightly Compact
 Co : Compact
 M/De : Medium Dense
 De : Dense
 V/De : Very Dense



TYPICAL SOIL PARAMETERS

See Table 2 for typical values of soil parameters

BRACED WALL

For $\gamma H/c \leq 4$

$$P_1 = 0.3 \gamma' H$$

$$P_w = \gamma_w H = 62.4 H$$

$$P_q = 0.5 q$$

Where:

γ'_c = Submerged unit weight of cohesive soil, pcf;

γ_w = Unit weight of water, pcf;

q = Surcharge load at surface, psf;

P_a = Lateral pressure, psf;

P_1 = Active earth pressure, psf;

P_q = Horizontal pressure due to surcharge, psf;

P_w = Hydrostatic pressure due to groundwater, psf;

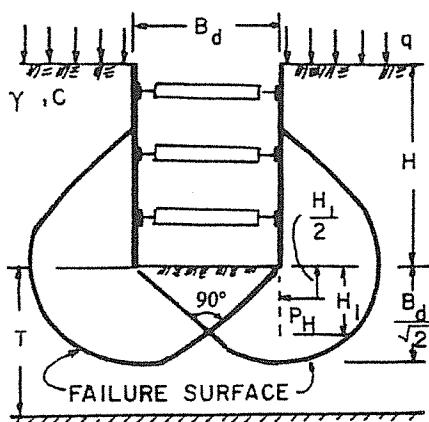
H = Depth of braced excavation, feet

c = Shear strength of cohesion soil, psf;

TRENCH SUPPORT EARTH PRESSURE

SUBMERGED COHESIVE SOIL

CUT IN COHESIVE SOIL,
DEPTH OF COHESIVE SOIL UNLIMITED ($T > 0.7 B_d$)
 L = LENGTH OF CUT



If sheeting terminates at base of cut:

$$\text{Safety factor, } F_s = \frac{N_c C}{\gamma H + q}$$

N_c = Bearing capacity factor, which depends on dimensions of the excavation : B_d , L and H (use N_c from graph below)

C = Undrained shear strength of clay in failure zone beneath and surrounding base of cut

γ = Wet unit weight of soil (see Table 2)

q = Surface surcharge (assume $q = 500$ psf)

If safety factor is less than 1.5, sheeting or soldier piles must be carried below the base of cut to insure stability - (see note)

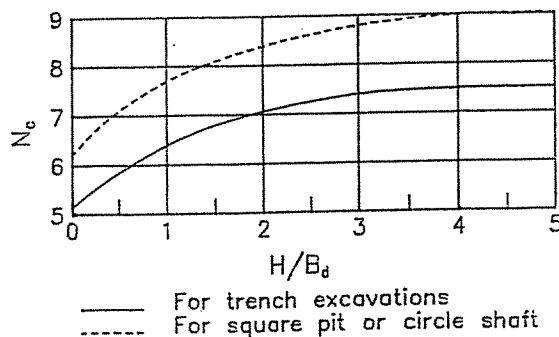
$$H_1 = \text{Buried length} = \frac{B_d}{2} \geq 5 \text{ feet}$$

Note : If soldier piles are used, the center to center spacing should not exceed 3 times the width or diameter of soldier pile .

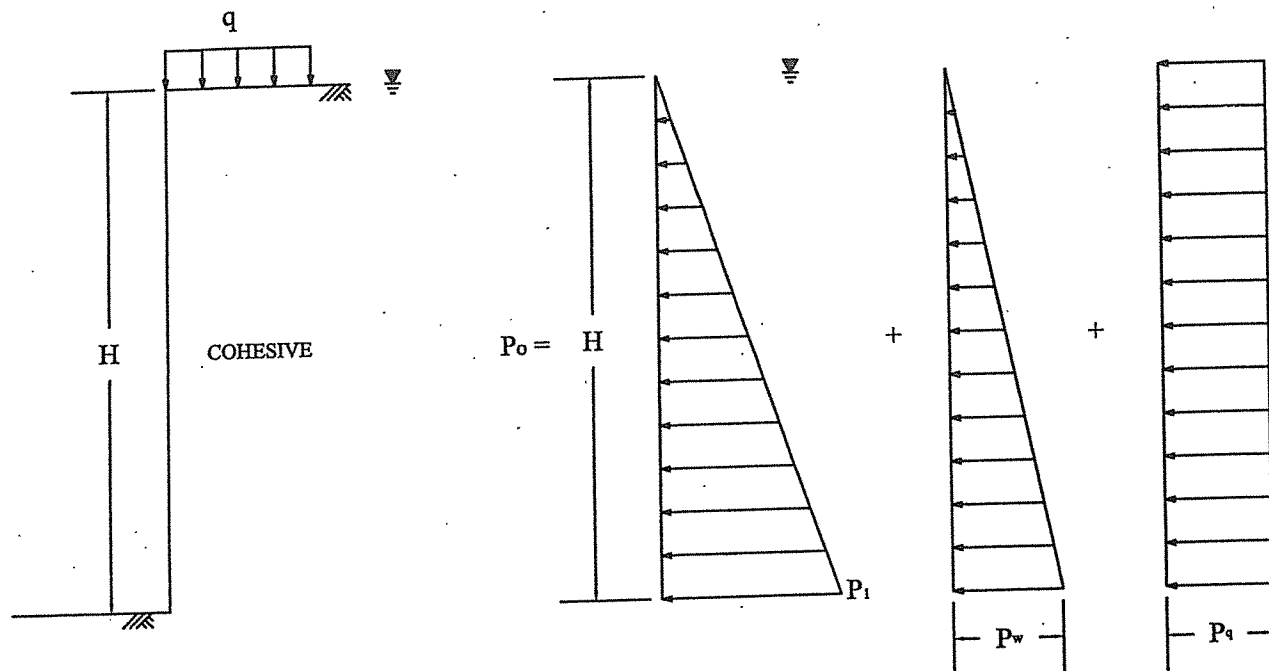
Force on buried length, P_H :

$$\text{If } H_1 > \frac{2}{3} \frac{B_d}{\sqrt{2}}, \quad P_H = 0.7 (\gamma H B_d - 1.4 C H - \pi C B_d) \text{ in lbs/ linear foot}$$

$$\text{If } H_1 < \frac{2}{3} \frac{B_d}{\sqrt{2}}, \quad P_H = 1.5 H_1 \left(\gamma H - \frac{1.4 C H}{B_d} - \pi C \right) \text{ in lbs/ linear foot}$$



STABILITY OF BOTTOM
FOR
BRACED CUT



TYPICAL SOIL PARAMETERS

See Table 2 for typical values of soil parameters

$$K_{oc} = 1.0$$

PERMANENT WALL

$$P_1 = K_{oc} \gamma'_c H$$

$$P_w = \gamma_w H = 62.4 H$$

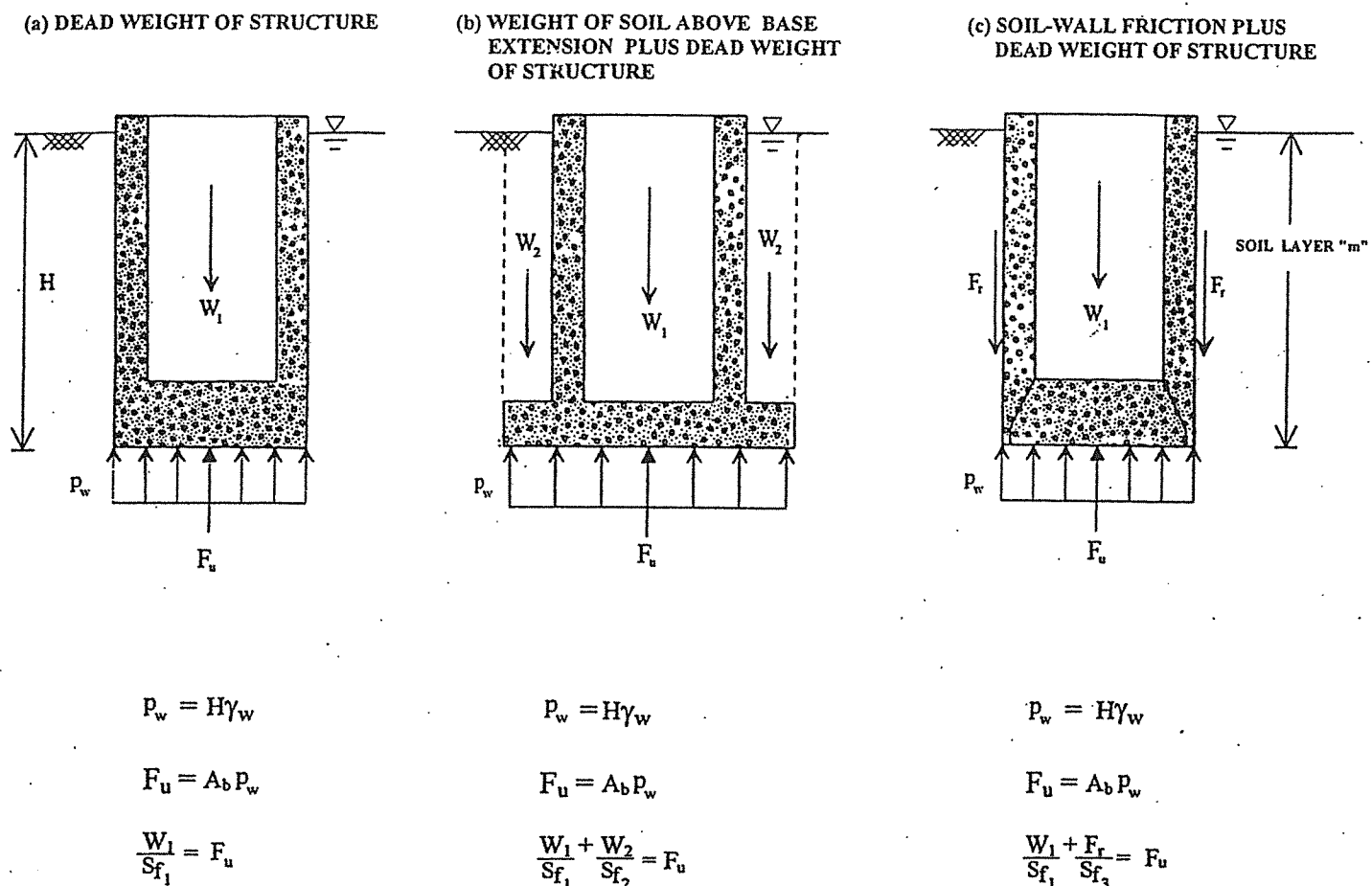
$$P_q = 0.5 q$$

Where:

- γ'_c = Submerged unit weight of cohesive soil, pcf;
- K_{oc} = Coefficient of at-rest earth pressure in cohesive soil;
- γ_w = Unit weight of water, pcf;
- q = Surcharge load at surface, psf;
- P_o = Lateral pressure, psf;
- P_1 = At-rest earth pressure, psf;
- P_q = Horizontal pressure due to surcharge, psf;
- P_w = Hydrostatic pressure due to groundwater, psf;
- H = Depth of excavation, feet

LATERAL EARTH PRESSURE DIAGRAM FOR PERMANENT WALL

SUBMERGED COHESIVE SOIL



See Table 2 for typical
values of soil parameters

Predominantly Cohesive Soils, $F_r = \alpha c_m A_m$

Predominantly Cohesionless Soils, $F_r = p_m A_m K \tan \delta_m$

Where:	A_b	=	area of base, sq. ft.
	A_m	=	cylindrical surface area of layer "m", sq. ft.
	c_m	=	undrained cohesion of soil layer "m", psf.
	F_u	=	hydrostatic uplift force, lbs.
	F_r	=	frictional resistance, lbs.
	H	=	height of buried structure, ft.
	K	=	coefficient of lateral pressure = 0.5.
	p_m	=	average overburden pressure for layer "m", psf.
	P_w	=	hydrostatic uplift pressure, psf.
	$S_{f_1, 2, 3}$	=	factor of safety.
	W_1	=	dead weight of concrete structure, lbs.
	W_2	=	weight of backfill above base extension, lbs.
	α	=	cohesion reduction factor = 0.5.
	δ_m	=	friction angle between soil layer "m" and concrete wall, degrees = $0.75 \phi_m$
	ϕ_m	=	internal angle of friction of soil layer "m", degrees.
	γ_w	=	unit weight of water = 62.4 pcf.

UPLIFT PRESSURE AND RESISTANCE

TABLES

	<u>Table</u>
Summary of Boring Information.....	1
Geotechnical Design Parameter Summary – Open Cut Excavation.....	2

TABLE 1
SUMMARY OF BORING INFORMATION

Boring No.	Depth (feet)	Street	Northing	Easting	Elevation (feet)
GB-1 (GB-1P)	25	LINCOLNSHIRE	3129627.2726	13792624.9524	49.55
GB-2	25	LINCOLNSHIRE	3130087.2086	13792638.5094	47.94
GB-3	25	LINCOLNSHIRE	3130593.7160	13792652.1646	47.06
GB-4	25	LINCOLNSHIRE	3131717.0874	13792678.7612	45.91
GB-5A	25	LINCOLNSHIRE	3132246.8970	13792693.1056	45.80
GB-6	25	GLENGARRY	3129741.1573	13792166.8724	50.39
GB-7	25	GLENGARRY	3130099.1195	13792174.4801	48.20
GB-8	25	GLENGARRY	3130646.8397	13792192.8060	47.52
GB-9	25	GLENGARRY	3131763.6159	13792221.2548	46.45
GB-10 (GB-10P)	25	GLENGARRY	3132292.7453	13792237.0772	46.27
GB-11	20	ALLISON	3130101.6697	13791564.7876	49.97
GB-12 (GB-12P)	25	ALLISON	3130684.6716	13791581.6161	47.67
GB-13	25	ALLISON	3131900.0083	13791621.0170	47.19
GB-14	30	COTTINGHAM	3131264.0053	13791648.3166	47.59
GB-15	30	COTTINGHAM	3131258.7773	13792191.8887	47.32
GB-16	31	COTTINGHAM	3131235.0439	13792649.0115	46.78
GB-17 (GB-17P)	31	COTTINGHAM	3131240.9951	13793129.4289	46.31
GB-18	32	COTTINGHAM	3131246.8570	13793588.4001	44.60
GB-19	20	HENDRICKSEN	3132355.7845	13791671.8124	47.69
GB-20	25	HENDRICKSEN	3132317.1862	13793183.7042	45.22
GB-21	25	LEA	3130040.1153	13793095.0361	47.16

TABLE 2
GEOTECHNICAL DESIGN PARAMETER SUMMARY
OPEN-CUT EXCAVATION

Alignments	Boring Nos.	Stratigraphic Unit	Range of Depths, ft	Wet Unit Weight, γ , pcf	Submerged Unit Weight, γ' , pcf	Undrained Cohesion, psf	Internal Friction Angle, ϕ , degree
Water line, Storm Sewer and Sanitary Sewer Along Lincolnshire	GB-1	Cohesive	0-2	126	63	500	--
			2-6	125	63	1,000	--
			6-10	120	60	1,500	--
			10-16	126	63	2,000	--
		Cohesionless Cohesive	16-23	104	52	--	25
			23-25	125	63	2,000	--
	GB-2	Cohesive	0-2	123	62	600	--
			2-12	120	60	1,800	--
			12-14	120	60	500	--
			14-17	106	53	--	25
		Cohesionless Cohesive	17-25	125	63	2,800	--
	GB-3 thru GB-5A and GB-16	Cohesive	0-14	118	59	1,000	--
			14-25	125	63	1,500	--
			25-31	125	63	2,000	--
			(GB-16 only)				
Water line, Storm Sewer and Sanitary Sewer along Glengarry	GB-6	Cohesive	0-6	128	64	1,200	--
		Cohesionless	6-23.5	123	62	2,200	--
			23.5-25	110	55	--	30
	GB-7 thru GB-10	Cohesive	0-8	125	63	800	--
			8-16	130	65	1,600	--
			16-18	125	63	1,000	--
			18-25	126	63	1,200	--
	GB-15	Fill	0-6	125	63	1,500	--
		Cohesive	6-20	120	60	500	--
			20-22	125	63	2,500	--
Water line, Storm Sewer and Sanitary Sewer along Allison	GB-11 thru GB-14 and GB-19	Cohesive	22-30	125	63	1,200	--
			0-6	115	58	1,500	--
			6-10	115	58	1,000	--
			10-14	120	60	1,500	--
			14-16	125	63	500	--
			16-20	126	63	1,200	--
			20-25	125	63	2,200	--
			25-28	125	63	400	--
			(GB-14 only)				
			28-30	125	63	500	--
			(GB-14 only)				
Water line, Storm Sewer and Sanitary Sewer along Cottingham	GB-14, GB-16 and GB-17	Cohesive	0-12	123	62	1,200	--
			12-20	125	63	1,800	--
			20-28	126	63	1,500	--
			28-31	125	63	500	--
	GB-15	Fill	0-6	125	63	1,500	--
		Cohesive	6-20	120	60	500	--
			20-22	125	63	2,500	--
			22-30	125	63	1,200	--

TABLE 2
GEOTECHNICAL DESIGN PARAMETER SUMMARY
OPEN-CUT EXCAVATION

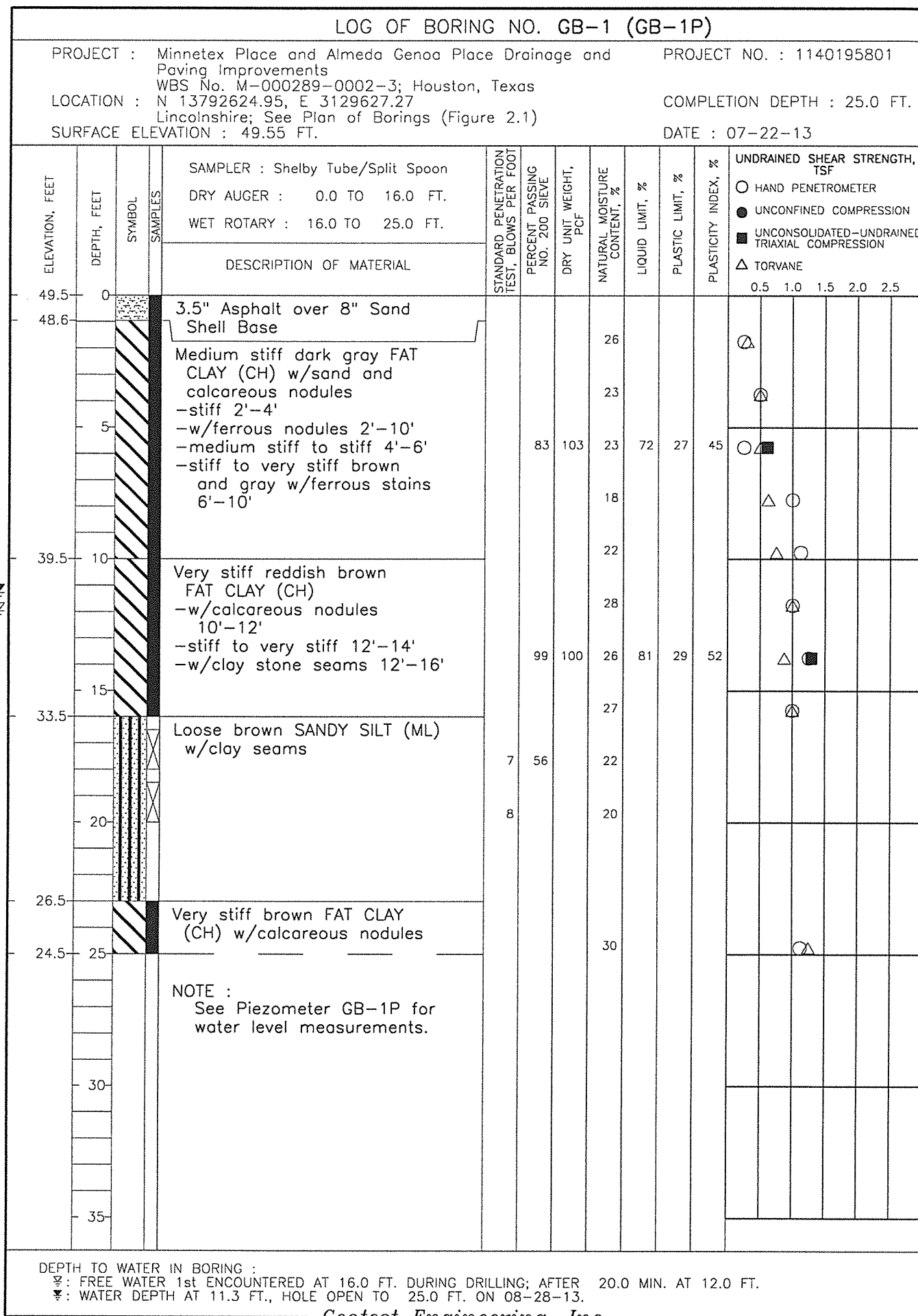
Alignments	Boring Nos.	Stratigraphic Unit	Range of Depths, ft	Wet Unit Weight, γ , pcf	Submerged Unit Weight, γ' , pcf	Undrained Cohesion, psf	Internal Friction Angle, ϕ , degree
Water line, Storm Sewer and along MLK	GB-18	Cohesive	0-8	112	51	3,100	--
			8-12	120	60	1,200	--
			12-14	125	63	800	--
			14-32	125	63	2,000	--
Water line, Storm Sewer and Sanitary Sewer along Hendricksen	GB-5A, GB-10, GB-19 and GB-20	Cohesive	0-8	123	63	1,000	--
			8-14	130	65	1,600	--
			14-25	124	62	1,600	--
Water line, Storm Sewer and Sanitary Sewer along Lea	GB-2	Cohesive	0-2	123	62	600	--
			2-12	120	60	1,800	--
			12-14	120	60	500	--
		Cohesionless Cohesive	14-17	106	53	--	25
			17-25	125	63	2,800	--
	GB-7 and GB-11	Cohesive	0-6	125	63	1,600	--
			6-12	130	65	1,000	--
			12-20	125	63	1,200	--
			20-25	126	63	2,100	--
			(GB-7 only)				
	GB-21	Cohesive	0-14	130	65	2,000	--
			14-16	125	63	800	--
		Cohesionless Cohesive	16-18	110	55	--	30
			18-20	120	60	500	--
			20-25	125	63	3,000	--

Note: 1) Fill soils include lean clay with sand and fat clay with wood and shell fragments
2) Cohesive soils include Fat Clay, Fat Clay with sand, Lean Clay, Lean Clay with sand and Sandy Lean Clay.
3) Cohesionless soils include Silty Sand and Sandy Silt.

APPENDIX A

Figure

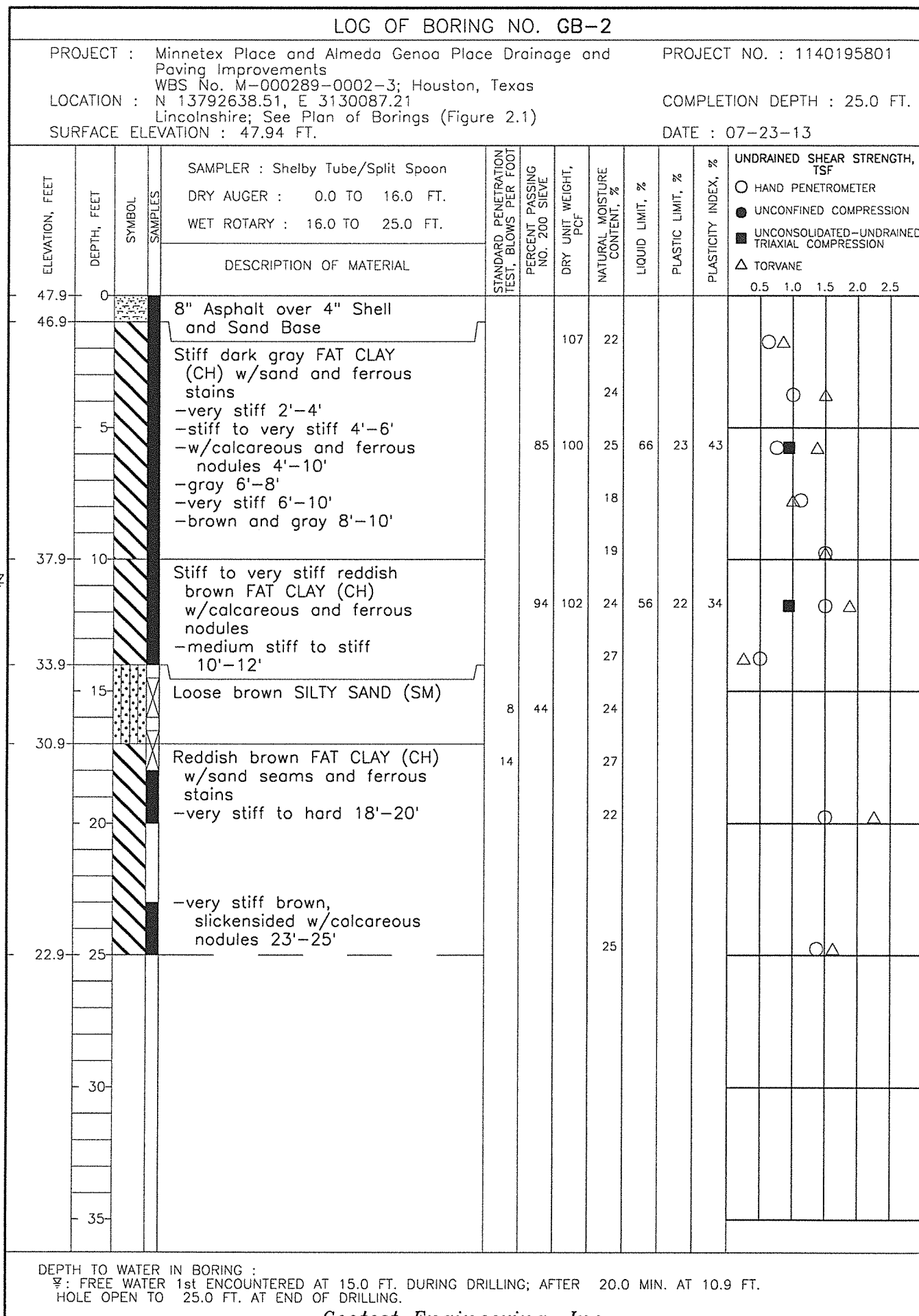
Log of Borings	A-1 thru A-21
Symbols and Terms Used on Boring Logs	A-22
Piezometer Installation Report.....	A-23 and A-26



DEPTH TO WATER IN BORING :
 ♀: FREE WATER 1st ENCOUNTERED AT 16.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 12.0 FT.
 ♀: WATER DEPTH AT 11.3 FT., HOLE OPEN TO 25.0 FT. ON 08-28-13.

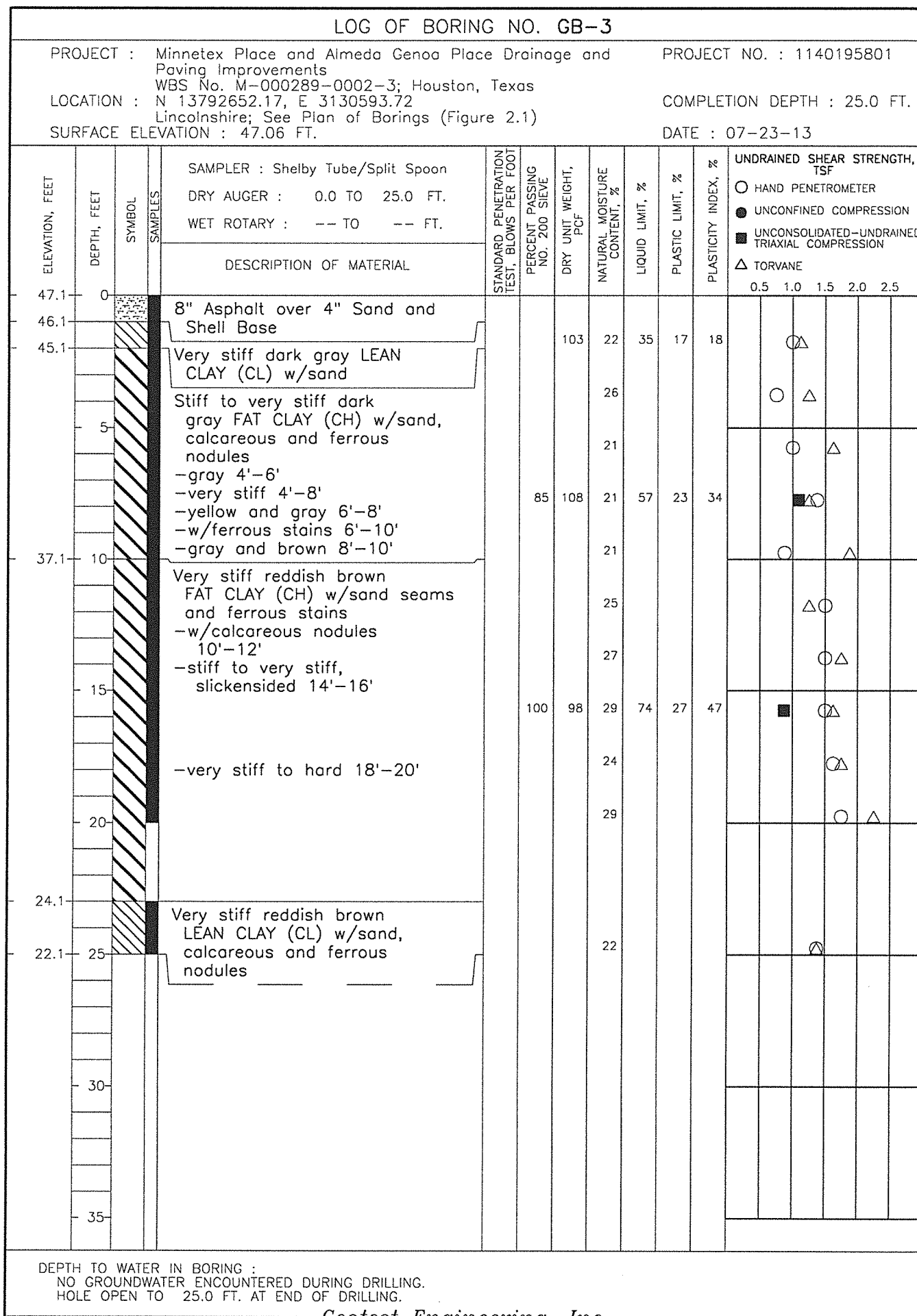
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FIGURE A-1



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FIGURE A-2



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FIGURE A-3

LOG OF BORING NO. GB-4												
PROJECT : Minnetex Place and Alameda Genoa Place Drainage and Paving Improvements WBS No. M-000289-0002-3; Houston, Texas LOCATION : N 13792678.76, E 3131717.09 Lincolnshire; See Plan of Borings (Figure 2.1) SURFACE ELEVATION : 45.91 FT.							PROJECT NO. : 1140195801 COMPLETION DEPTH : 25.0 FT. DATE : 07-23-13					
ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLER : Shelby Tube/Split Spoon DRY AUGER : 0.0 TO 25.0 FT. WET ROTARY : -- TO -- FT.	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF ○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE
45.9	0			8" Asphalt over 4" Sand and Shell Base				31				
44.9				Stiff to very stiff dark gray FAT CLAY (CH) w/ferrous stains -stiff w/sand seams 4'-6'				30				
	5			-yellow and gray 6'-8' -w/ferrous nodules 6'-12'		93	88	33	84	30	54	
				-yellow and brown 8'-10' -w/calcareous nodules and ferrous stains 8'-12'				30				
	10			-w/silt seams 10'-12' -reddish brown 10'-18'				29				
				-slickensided 14'-16'				30				
	15							33				
				-very stiff gray and brown 18'-25'		100	98	29	74	27	47	
	20							31				
				-w/silt layer 23'-24'				21				
	25					99		26	67	25	42	
	30											
	35											

DEPTH TO WATER IN BORING :
 ∇: FREE WATER 1st ENCOUNTERED AT 23.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 20.6 FT.
 HOLE OPEN TO 25.0 FT. AT END OF DRILLING.

DEPTH TO WATER IN BORING :
 ∅: FREE WATER 1st ENCOUNTERED AT 23.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 20.6 FT.
 HOLE OPEN TO 25.0 FT. AT END OF DRILLING.

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FIGURE A-4

LOG OF BORING NO. GB-5

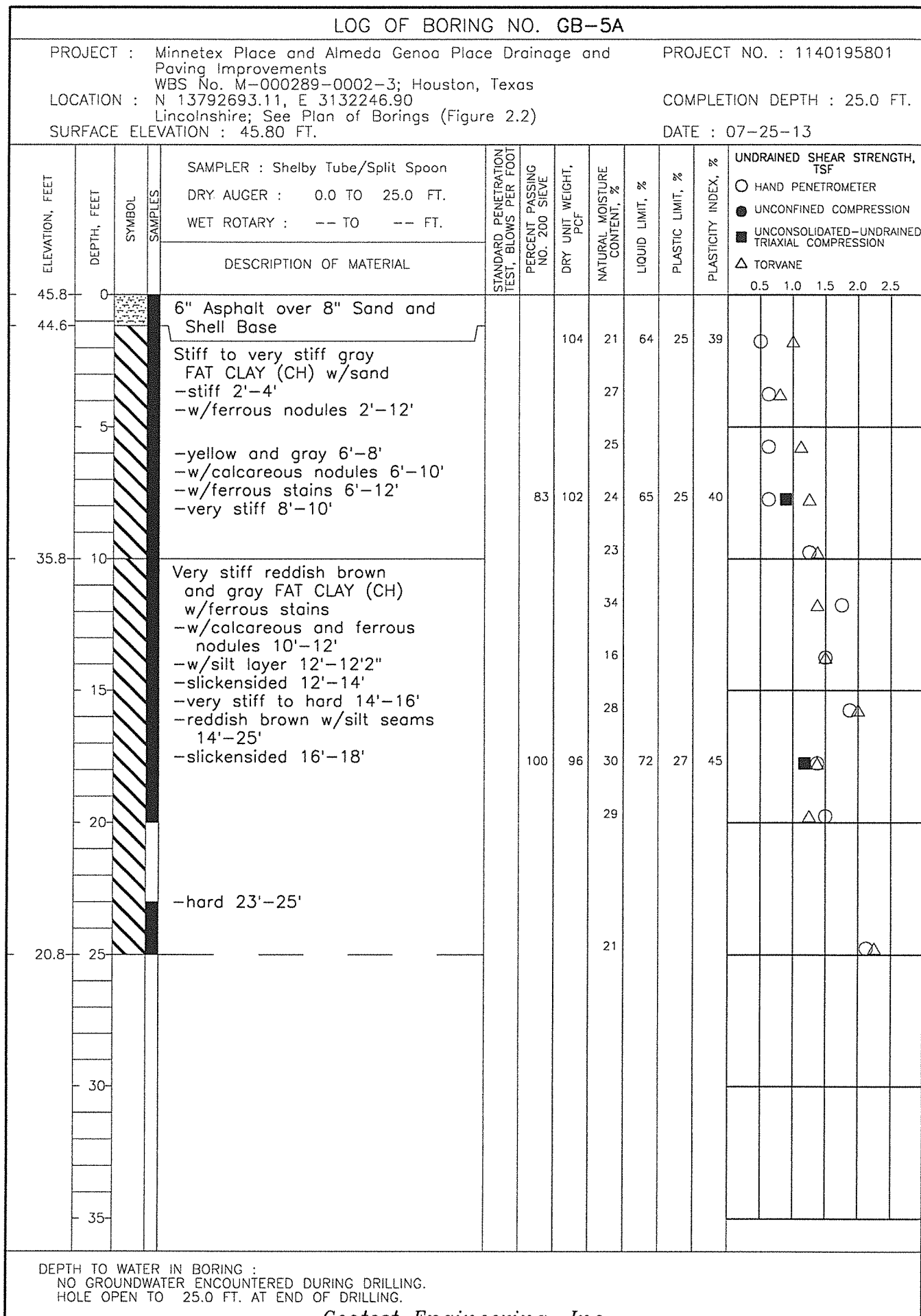
PROJECT : Minnetex Place and Alameda Genoa Place Drainage and Paving Improvements
WBS No. M-000289-0002-3; Houston, Texas
LOCATION : N 13792693.11, E 3132246.90
Lincolnshire; See Plan of Borings (Figure 2.2)
SURFACE ELEVATION : 45.80 FT.

PROJECT NO. : 1140195801
COMPLETION DEPTH : 2.7 FT.
DATE : 07-25-13

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF				
												○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE				
45.8	0			SAMPLER : Shelby Tube/Split Spoon DRY AUGER : 0.0 TO 2.7 FT. WET ROTARY : -- TO -- FT.								0.5	1.0	1.5	2.0	2.5
44.8				8" Asphalt over 4" Sand and Shell Base												
43.1				FILL: 20" sand												
	5			NOTE : Hit hard obstruction at 2'7" and boring was offset to GB-5A.												
	10															
	15															
	20															
	25															
	30															
	35															

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 2.7 FT. AT END OF DRILLING.

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FIGURE A-5A

LOG OF BORING NO. GB-6

PROJECT : Minnetex Place and Alameda Genoa Place Drainage and Paving Improvements
WBS No. M-000289-0002-3; Houston, Texas
LOCATION : N 13792166.87, E 3129741.16
Glengarry; See Plan of Borings (Figure 2.1)
SURFACE ELEVATION : 50.39 FT.

PROJECT NO. : 1140195801
COMPLETION DEPTH : 25.0 FT.
DATE : 07-26-13

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF
												○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE
50.4	0			6" Asphalt over 6" Sand and Shell Base								
49.4				Stiff gray FAT CLAY (CH) w/sand and ferrous stains				17				○
				-medium stiff to stiff 2'-4'				24				○ △
	5			-w/calcareous nodules 2'-8'								
				-stiff to very stiff 4'-6'								
				-very stiff w/ferrous nodules 6'-10'	82	107	21	57	23	34		○ ■ △
				-gray and brown 8'-10'				20				○ △
40.4	10			Very stiff reddish brown FAT CLAY (CH) w/silt seams, ferrous stains and calcareous nodules				21				△ ○
				-very stiff to hard 12'-14'				24				△ ○
				-slickensided 14'-16'				27				○ △
	15				98	101	22	59	23	36		■ △
								19				△ ○
	20							22				△ ○
28.4				Reddish brown SANDY LEAN CLAY (CL) w/clayey sand seams				22				
26.9												
25.4	25			Medium dense reddish brown SILTY SAND (SM) w/clay seams	18	32		20				
	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 25.0 FT. AT END OF DRILLING.

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LOG OF BORING NO. GB-7

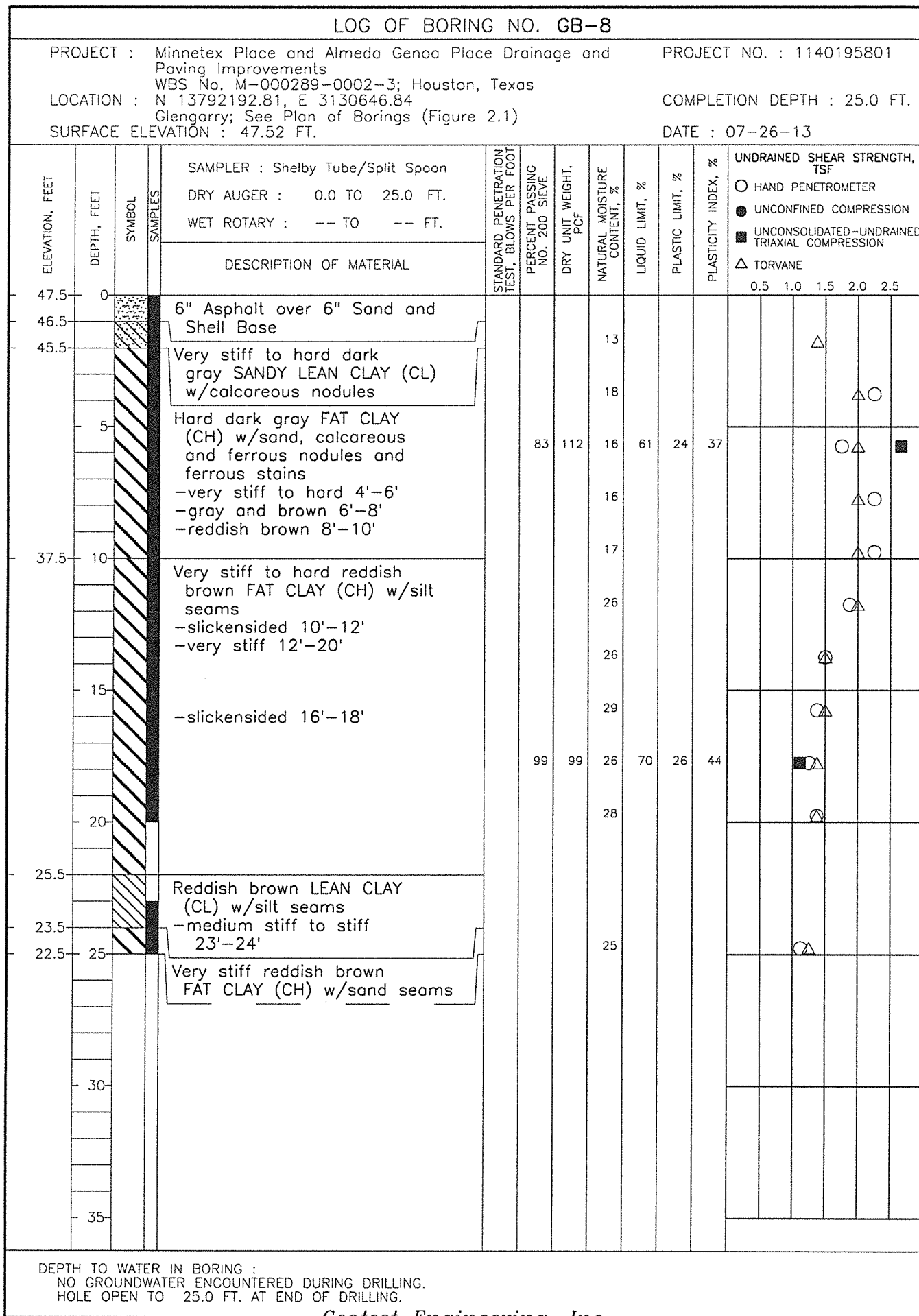
PROJECT : Minnetex Place and Alameda Genoa Place Drainage and Paving Improvements
WBS No. M-000289-0002-3; Houston, Texas
LOCATION : N 13792174.48, E 3130099.12
Glengarry at Lea; See Plan of Borings (Figure 2.1)
SURFACE ELEVATION : 48.20 FT.

PROJECT NO. : 1140195801
COMPLETION DEPTH : 25.0 FT.
DATE : 07-26-13

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF				
												○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE				
												0.5	1.0	1.5	2.0	2.5
48.2	0			8" Asphalt over 4" Sand and Shell Base			113	15	47	17	30					
47.2				Hard dark gray LEAN CLAY (CL) w/sand and ferrous stains				16								○
44.2				Very stiff dark gray FAT CLAY (CH) w/sand, calcareous and ferrous nodules and ferrous stains				20								○
	5			-stiff to very stiff yellow and gray 6'-8'		84	111	20	53	22	31	○	■	△		
				-gray and reddish brown 8'-10'				19								△
38.2	10			Very stiff reddish brown FAT CLAY (CH) w/silt seams, calcareous nodules and ferrous stains				29								○
				-very stiff to hard 14'-16'				26								○
	15			-slickensided 16'-18'				22								△
						98	104	25	66	25	41		■	○	△	
	20							26								○
																△
				-brown 23'-25'												
23.2	25							28								○
	30															
	35															

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 25.0 FT. AT END OF DRILLING.

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FIGURE A-8

LOG OF BORING NO. GB-9

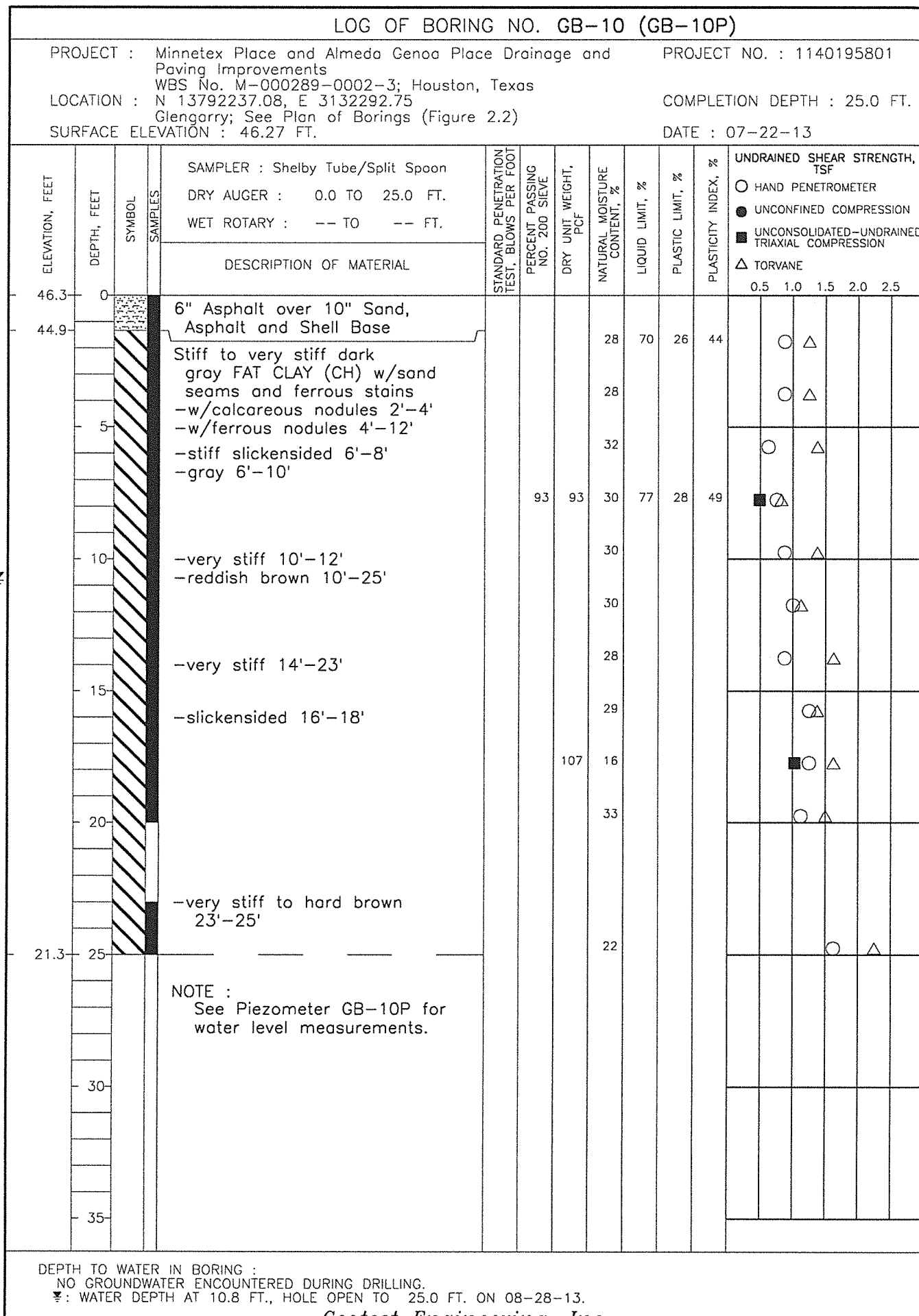
PROJECT : Minnetex Place and Alameda Genoa Place Drainage and Paving Improvements
WBS No. M-000289-0002-3; Houston, Texas
LOCATION : N 13792221.26, E 3131763.62
Glengarry; See Plan of Borings (Figure 2.1)
SURFACE ELEVATION : 46.45 FT.

PROJECT NO. : 1140195801
COMPLETION DEPTH : 25.0 FT.
DATE : 07-26-13

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF				
												○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE				
												0.5	1.0	1.5	2.0	2.5
46.5	0			6" Asphalt over 6" Sand and Shell Base												
45.5				Stiff to very stiff dark gray FAT CLAY (CH) w/ferrous stains				26								
				-w/sand seams 1.5'-10'			94	30	69	26	43	○	△			
	5			-medium stiff to stiff 2'-4'				29				○	△			
				-w/ferrous nodules 4'-10'												
				-medium stiff to stiff gray, slickensided 6'-8'												
				-gray and brown 8'-10'		91	92	32	69	26	43	■	△			
				-w/calcareous nodules and ferrous stains 8'-12'												
	10			-very stiff 8'-16'				27				○	△			
				-reddish brown w/silt seams 10'-16'												
								25						○	△	
								28						△		
	15							30						△	○	
30.5				Medium stiff to stiff gray LEAN CLAY (CL) w/ferrous stains		93	108	22	36	17	19	■	△			
28.5				Very stiff reddish brown FAT CLAY (CH) w/silt seams and ferrous stains				30						△	○	
	20			-slickensided 18'-20'												
				-w/silt layer 22'-23'												
				-w/sand and silt seams 24'-25'				27								
21.5	25															
	30															
	35															

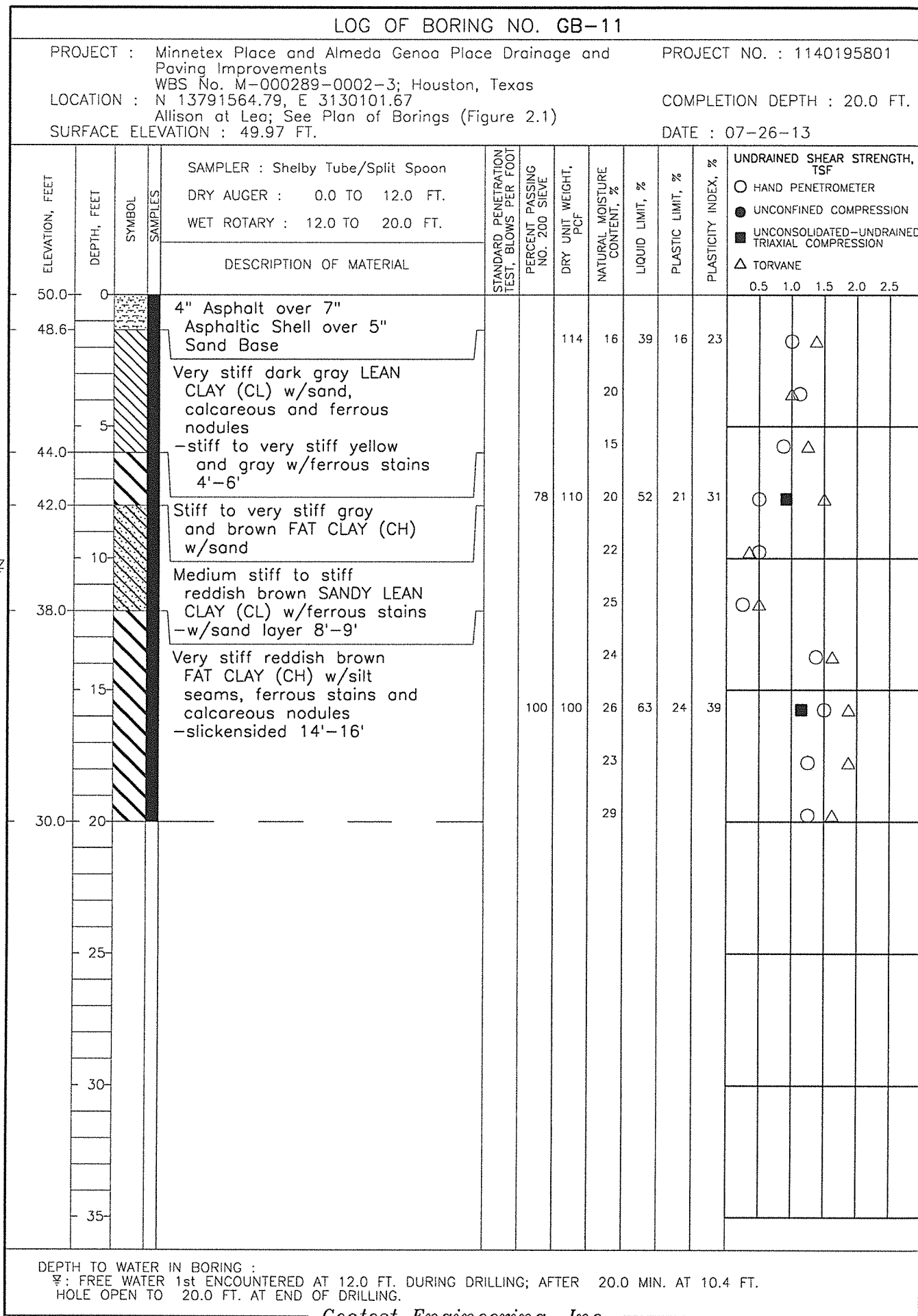
DEPTH TO WATER IN BORING :
 ☼: FREE WATER 1st ENCOUNTERED AT 22.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 17.0 FT.
 HOLE OPEN TO 25.0 FT. AT END OF DRILLING.

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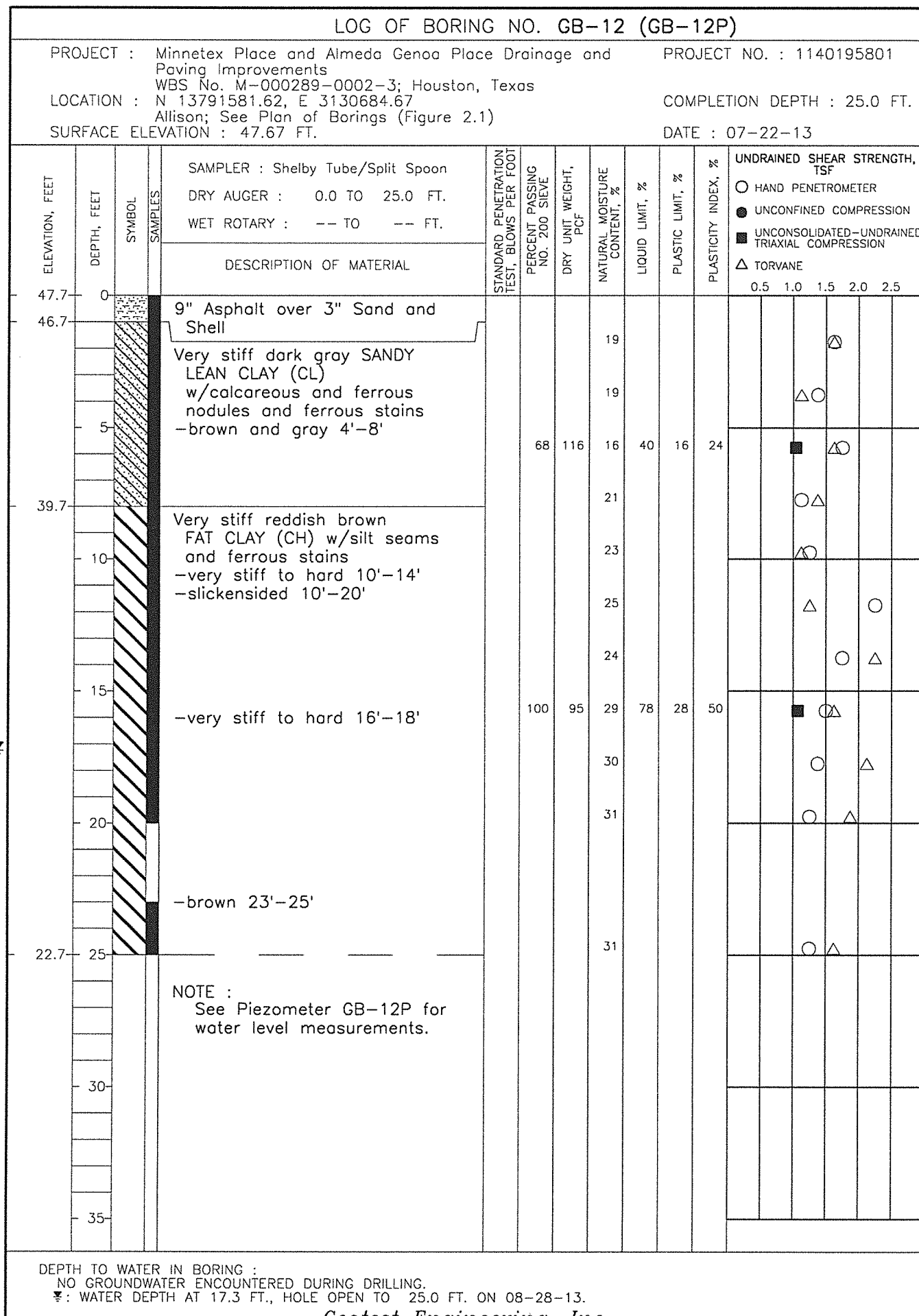
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FIGURE A-10



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FIGURE A-11



DEPTH TO WATER IN BORING :
 NO GROUNDWATER ENCOUNTERED DURING DRILLING.
 ♣: WATER DEPTH AT 17.3 FT., HOLE OPEN TO 25.0 FT. ON 08-28-13.

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FIGURE A-12

LOG OF BORING NO. GB-13

PROJECT : Minnetex Place and Alameda Genoa Place Drainage and Paving Improvements
WBS No. M-000289-0002-3; Houston, Texas
LOCATION : N 13791621.02, E 3131900.01
Allison; See Plan of Borings (Figure 2.1)
SURFACE ELEVATION : 47.19 FT.

PROJECT NO. : 1140195801
COMPLETION DEPTH : 25.0 FT.
DATE : 07-25-13

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	SAMPLER : Shelby Tube/Split Spoon DRY AUGER : 0.0 TO 18.0 FT. WET ROTARY : 18.0 TO 25.0 FT.	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF						
				DESCRIPTION OF MATERIAL								○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE	0.5	1.0	1.5	2.0	2.5	
47.2	0			3" Asphalt over 6" Shell Base														
46.4				Stiff to very stiff dark gray LEAN CLAY (CL) w/sand, shell and gravel				24						○		△		
45.2									27						○△			
	5			Very stiff dark gray FAT CLAY (CH) w/ferrous stains -w/calcareous nodules 2'-12' -stiff to very stiff 4'-10' -gray 4'-12' -w/ferrous nodules 6'-10'		87	97	26	66	25	41			■△				
									25						○		△	
	10			-reddish brown w/silt seams 12'-25' -medium stiff to stiff slickensided 14'-16'				26						○		△		
									27						○			
								29						○		△		
	15					100	88	35	82	29	53			■△				
									31						○		△	
	20							30						○		△		
24.2				Very stiff reddish brown LEAN CLAY (CL) w/ferrous stains				27						○		△		
22.2	25																	
	30																	
	35																	

DEPTH TO WATER IN BORING :
 ∅: FREE WATER 1st ENCOUNTERED AT 18.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 13.3 FT.
 HOLE OPEN TO 25.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-13

LOG OF BORING NO. GB-14

PROJECT : Minnetex Place and Alameda Genoa Place Drainage and Paving Improvements
WBS No. M-000289-0002-3; Houston, Texas
LOCATION : N 13791648.32, E 3131264.01
Cottingham; See Plan of Borings (Figure 2.1)
SURFACE ELEVATION : 47.59 FT.

PROJECT NO. : 1140195801
COMPLETION DEPTH : 30.0 FT.
DATE : 07-25-13

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF
												○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE
47.6	0			6" Asphalt over 10" Shell and Sand Base								
46.3				Very stiff dark gray FAT CLAY (CH) w/sand, ferrous nodules and ferrous stains				20				
				-stiff to very stiff 2'-4'				23				
	5			-gray 4'-6'								
				-w/calcareous nodules and sand seams 4'-8'	75	111	17	51	21	30		
				-very stiff to hard gray and brown 6'-8'				16				
39.6				Stiff to very stiff reddish brown FAT CLAY (CH) w/silt seams and ferrous stains				23				
	10			-w/calcareous and ferrous nodules 8'-10'				25				
				-very stiff 10'-14'				31				
	15			-slickensided 14'-16'								
				-very stiff 16'-18'	100	93	31	77	28	49		
				-very stiff to hard 18'-20'				28				
	20							29				
				-hard w/calcareous nodules, slickensided 23'-25'	98		22	60	24	36		
	25											
19.6				Medium stiff to stiff reddish brown LEAN CLAY (CL) w/sand seams and ferrous stains				27				
17.6	30											
	35											

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 30.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-15

PROJECT : Minnetex Place and Alameda Genoa Place Drainage and Paving Improvements
 WBS No. M-000289-0002-3; Houston, Texas
 LOCATION : N 13792191.89, E 3131258.78
 Cottingham; See Plan of Borings (Figure 2.1)
 SURFACE ELEVATION : 47.32 FT.

PROJECT NO. : 1140195801
 COMPLETION DEPTH : 30.0 FT.
 DATE : 07-25-13

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	SAMPLER : Shelby Tube/Split Spoon DRY AUGER : 0.0 TO 22.0 FT. WET ROTARY : 22.0 TO 30.0 FT.	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF				
				DESCRIPTION OF MATERIAL								○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE				
												0.5	1.0	1.5	2.0	2.5
47.3	0			6" Asphalt over 12" Sand and Shell Base												
45.8				FILL: dark gray lean clay w/sand				17								
				-w/shell, gravel and rock 1.5'-20'				23				△				
	5			-stiff 2'-4'												
				-medium stiff w/wood 4'-6'				31				△				
				-fat clay 4'-20'												
				-medium stiff to stiff 6'-8'		75	96	26	61	24	37	●				
				-w/wood 8'-10'												
				-medium stiff 8'-16'				28				△				
	10							35				△				
				-w/wood 12'-16'												
				-w/shell layer 14'-18'				32				△				
	15							27				△				
				-medium stiff to stiff 16'-18'				33				△				
				-reddish brown 16'-20'												
27.3	20			Very stiff reddish brown LEAN CLAY (CL) w/calcareous nodules and ferrous stains		98	107	21	45	22	23		■			
23.3	25			Stiff to very stiff reddish brown FAT CLAY (CH) w/shell fragments and ferrous stains				30				△	○			
				-very stiff 28'-30'												
17.3	30							27						△	○	
	35															

DEPTH TO WATER IN BORING :
 ∇: FREE WATER 1st ENCOUNTERED AT 22.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 17.2 FT.
 HOLE OPEN TO 30.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-16

PROJECT : Minnetex Place and Alameda Genoa Place Drainage and Paving Improvements
WBS No. M-000289-0002-3; Houston, Texas
LOCATION : N 13792649.01, E 3131235.04
Cottingham; See Plan of Borings (Figure 2.1)
SURFACE ELEVATION : 46.78 FT.

PROJECT NO. : 1140195801

COMPLETION DEPTH : 31.0 FT.

DATE : 07-25-13

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF				
												○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE				
												0.5	1.0	1.5	2.0	2.5
46.8	0			6" Asphalt over 12" Shell and Clay Mix												
45.3				Stiff to very stiff dark gray FAT CLAY (CH) w/ferrous stains			93	29	69	26	43	○		△		
				-w/sand seams 18"-12'								○	△			
	5			-gray w/calcareous and ferrous nodules 6'-10'				30				○	△			
					93	96	29	75	28	47		■	△			
	10			-stiff 10'-12'				29				○	△			
				-reddish brown 10'-31'												
				-very stiff w/silt seams 12'-20'				31				△				
								28						○	△	
	15							23						○	△	
								30				○	△			
	20							26						○	△	
				-w/calcareous nodules 23'-25'												
	25				97	104	24	64	25	39		■		△	○	
				-very stiff 28'-30'												
				-w/silt seams 28'-31'												
	30			-very stiff to hard 30'-31'				25						○	△	
15.8								27						○	△	
	35															

DEPTH TO WATER IN BORING :
 ∇: FREE WATER 1st ENCOUNTERED AT 28.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 18.3 FT.
 HOLE OPEN TO 31.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

LOG OF BORING NO. GB-17 (GB-17P)													
PROJECT : Minnetex Place and Alameda Genoa Place Drainage and Paving Improvements WBS No. M-000289-0002-3; Houston, Texas										PROJECT NO. : 1140195801			
LOCATION : N 13793129.43, E 3131240.99 Cottingham; See Plan of Borings (Figure 2.1)										COMPLETION DEPTH : 31.0 FT.			
SURFACE ELEVATION : 46.31 FT.										DATE : 07-22-13			
ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	SAMPLER : Shelby Tube/Split Spoon DRY AUGER : 0.0 TO 22.0 FT. WET ROTARY : 22.0 TO 31.0 FT.	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF
													○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE 0.5 1.0 1.5 2.0 2.5
46.3	0				6" Asphalt over 12" Sand and Shell Base								
44.8					Stiff to very stiff dark gray FAT CLAY (CH) w/sand seams and ferrous stains				21				○ △
	5				-w/ferrous nodules 6'-10'		86	104	22	55	22	33	○ ■ △
38.3					Stiff to very stiff brown and gray LEAN CLAY (CL) w/sand, ferrous stains and calcareous nodules				24				○ △
	10				-stiff 10'-12'				27				○ △
34.3					Very stiff reddish brown FAT CLAY (CH) w/ferrous stains		82		21	36	19	17	○ △
	15				-w/calcareous nodules 12'-14'				27				△ ○
					-slickensided 16'-18'				31				○ △
					-very stiff to hard 18'-20'		100	95	30	70	26	44	○ ■ △
	20								34				○ △
					-slickensided 23'-25'				24				
					-w/silt partings 23'-30'		99	101	24	63	24	39	■ ○ △
	25												
									26				○ △
	30								29				○ △
15.3													
					NOTE : See Piezometer GB-17P for water level measurements.								
	35												

DEPTH TO WATER IN BORING :
 ∇ : FREE WATER 1st ENCOUNTERED AT 22.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 16.8 FT.
 ∇ : WATER DEPTH AT 15.8 FT., HOLE OPEN TO 31.0 FT. ON 08-28-13.

☐: FREE WATER 1st ENCOUNTERED AT 22.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 16.8 FT.
 ☒: WATER DEPTH AT 15.8 FT., HOLE OPEN TO 31.0 FT. ON 08-28-13.

W: WATER DEPTH AT 15.8 FT., HOLE OPEN TO 31.0 FT. ON 08-28-13.

FIGURE A-17

LOG OF BORING NO. GB-18

PROJECT : Minnetex Place and Alameda Genoa Place Drainage and Paving Improvements
WBS No. M-000289-0002-3; Houston, Texas
LOCATION : N 13793588.40, E 3131246.86
Martin Luther King; See Plan of Borings (Figure 2.2)
SURFACE ELEVATION : 44.60 FT.

PROJECT NO. : 1140195801
COMPLETION DEPTH : 32.0 FT.
DATE : 07-25-13

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF				
												○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE				
44.6	0			SAMPLER : Shelby Tube/Split Spoon DRY AUGER : 0.0 TO 32.0 FT. WET ROTARY : -- TO -- FT.								0.5	1.0	1.5	2.0	2.5
				Hard dark gray FAT CLAY (CH) -w/calcareous and ferrous nodules and roots 0'-6' -w/ferrous stains 2'-8' -very stiff to hard 4'-6'				15								⊗
								15								⊗
	5			-stiff to very stiff gray and brown slickensided 6'-8'				22								○
36.6					89	96	28	72	27	45		○	■	△		
				Stiff gray and brown SANDY LEAN CLAY (CL) w/calcareous and ferrous nodules -gray sand stone 10'-12'				31				△	○			
32.6								15								
30.6				Medium stiff to stiff gray and brown FAT CLAY (CH) w/sand and ferrous nodules	78		25	61	24	37		○		△		
	15			Very stiff reddish brown FAT CLAY (CH) w/silt seams and ferrous stains				32					○	△		
				-stiff to very stiff gray and reddish brown slickensided 18'-20'				33					○	△		
	20				99	94	29	84	30	54		○	■	△		
				-w/calcareous nodules 23'-25' -very stiff to hard 23'-32'				22							○	△
	25															
				-slickensided 28'-30'				28							○	△
	30							28							○	△
12.6																
	35															

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 32.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

FIGURE A-18

LOG OF BORING NO. GB-19

PROJECT : Minnetex Place and Almeda Genoa Place Drainage and Paving Improvements
WBS No. M-000289-0002-3; Houston, Texas
LOCATION : N 13791671.81, E 3132355.79
Hendricksen; See Plan of Borings (Figure 2.2)
SURFACE ELEVATION : 47.69 FT.

PROJECT NO. : 1140195801
COMPLETION DEPTH : 20.0 FT.
DATE : 07-25-13

ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF				
												○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE				
47.7	0			16" Asphalt								0.5	1.0	1.5	2.0	2.5
46.4				Very stiff dark gray FAT CLAY (CH) w/calcareous nodules				26								
				-stiff to very stiff 2'-4'				27								
	5			-slickensided 4'-6'												
				-stiff 4'-8'		94	88	32	80	29	51					
				-gray 6'-8'												
				-yellowish brown and gray 8'-10'				29								
	10			-w/calcareous nodules and ferrous stains 8'-14'				26								
				-reddish brown w/silt seams 10'-20'				24								
				-stiff to very stiff slickensided 14'-16'				27								
	15					100	91	33	78	28	50					
								29								
27.7	20							29								
	25															
	30															
	35															

DEPTH TO WATER IN BORING :
NO GROUNDWATER ENCOUNTERED DURING DRILLING.
HOLE OPEN TO 20.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

[illegible]

LOG OF BORING NO. GB-21

PROJECT : Minnetex Place and Alameda Genoa Place Drainage and Paving Improvements
 WBS No. M-000289-0002-3; Houston, Texas
 LOCATION : N 13793095.04, E 3130040.12
 Lea at Swingle; See Plan of Borings (Figure 2.1)
 SURFACE ELEVATION : 47.16 FT.

PROJECT NO. : 1140195801
 COMPLETION DEPTH : 25.0 FT.
 DATE : 07-26-13

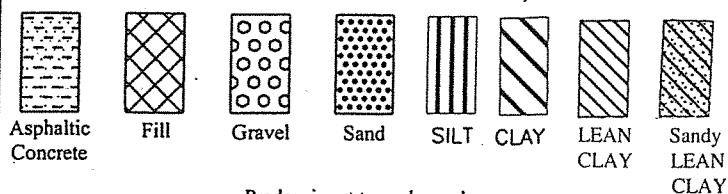
ELEVATION, FEET	DEPTH, FEET	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	STANDARD PENETRATION TEST, BLOWS PER FOOT	PERCENT PASSING NO. 200 SIEVE	DRY UNIT WEIGHT, PCF	NATURAL MOISTURE CONTENT, %	LIQUID LIMIT, %	PLASTIC LIMIT, %	PLASTICITY INDEX, %	UNDRAINED SHEAR STRENGTH, TSF				
												○ HAND PENETROMETER ● UNCONFINED COMPRESSION ■ UNCONSOLIDATED-UNDRAINED TRIAXIAL COMPRESSION △ TORVANE				
												0.5	1.0	1.5	2.0	2.5
47.2	0			SAMPLER : Shelby Tube/Split Spoon DRY AUGER : 0.0 TO 16.0 FT. WET ROTARY : 16.0 TO 25.0 FT.												
46.4				4" Asphalt over 5" Sand and Shell Base				26								
				Very stiff dark gray SANDY LEAN CLAY (CL) w/ferrous nodules and ferrous stains -gray 4'-6' -w/calcareous nodules 4'-8'				24								
	5					59	115	15	44	17	27					
39.2				Very stiff reddish brown FAT CLAY (CH) w/silt seams, calcareous and ferrous nodules				18								
37.2	10			Very stiff reddish brown LEAN CLAY (CL) -w/calcareous and ferrous nodules 10'-12'				24								
								26								
33.2	15			Medium stiff to stiff brown SANDY LEAN CLAY (CL) -w/sand stone 14'-16'				21								
31.2				Medium dense reddish brown SILTY SAND (SM) w/sand stone	12	43		21								
29.2	20			Medium stiff to stiff reddish brown SANDY LEAN CLAY (CL) w/sand stone and ferrous stains				21								
24.2				Very stiff reddish brown FAT CLAY (CH) w/calcareous and ferrous nodules and sand pockets				29								
22.2	25															
	30															
	35															

DEPTH TO WATER IN BORING :
 ∅ : FREE WATER 1st ENCOUNTERED AT 16.0 FT. DURING DRILLING; AFTER 20.0 MIN. AT 11.4 FT.
 HOLE OPEN TO 25.0 FT. AT END OF DRILLING.

Geotest Engineering, Inc.

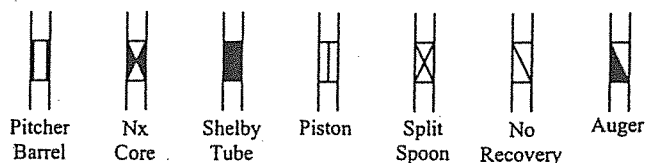
SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES (SHOWN IN SYMBOL COLUMN)



Predominant type shown heavy

SAMPLER TYPES (SHOWN IN SAMPLES COLUMN)



TERMS DESCRIBING CONSISTENCY OR CONDITION

Basic Soil Type	Density or Consistency	Standard Penetration Resistance, ⁽¹⁾ Blows/ft.	Unconfined Compressive Strength (q_u), ⁽²⁾ Tons/sq. ft.
Cohesionless	Very loose	Less than 4	Not applicable
	Loose	4 to <10	Not applicable
	Medium dense	10 to <30	Not applicable
	Dense	30 to <50	Not applicable
	Very dense	50 or greater	Not applicable
Cohesive	Very soft	Less than 2	Less than 0.25
	Soft	2 to <4	0.25 to <0.5
	Firm/Medium stiff	4 to <8	0.5 to <1.0
	Stiff	8 to <15	1.0 to <2.0
	Very stiff	15 to <30	2.0 to <4.0
	Hard	30 or greater	4 or greater

(1) Number of blows from 140-lb. weight falling 30-in. to drive 2-in. OD, 1-3/8-in. ID, split barrel sampler (ASTM D1586)

(2) q_u may also be approximated using a pocket penetrometer

TERMS CHARACTERIZING SOIL STRUCTURE

Parting: -paper thin in size

Seam: -1/8" to 3" thick

Layer: -greater than 3"

Slickensided

- having inclined planes of weakness that are slick and glossy in appearance.

Fissured

- containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.

Laminated

- composed of thin layers of varying color and texture.

Interbedded

- composed of alternate layers of different soil types.

Calcareous

- containing appreciable quantities of calcium carbonate.

Well graded

- having wide range in grain sizes and substantial amounts of all intermediate particle sizes.

Poorly graded

- predominantly of one grain size, or having a range of sizes with some intermediate size missing.

Flocculated

- pertaining to cohesive soils that exhibit a loose knit or flakey structure.

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: MINNETEX AREA AND ALMEDA GENOA PLACE PAVING AND DRAINAGE IMPROVEMENTS WBS NO. M-000289-0002-3		PIEZOMETER NUMBER: GB-1P
GEOTECHNICAL CONSULTANT GEOTEST ENGINEERING, INC.	DESIGN CONSULTANT KIT PROFESSIONALS, INC.	HOUSTON, TEXAS

COMPLETION DATE <u>07-22-13</u> DRY AUGERED <u>0</u> TO <u>16.0</u> FT WASH BORED <u>16.0</u> TO <u>25.0</u> FT DRILLING FLUID: <u>WATER</u>	DEPTH (FT) ELEV. (FT) 0 49.55 2 47.55 5 44.55 10 39.55 20 29.55 25 24.55 25 24.55										
DEVELOPMENT DATE: <u>07-22-13</u> METHOD OF DEVELOPMENT: <u>BAILING</u>											
WATER LEVEL READINGS: <table border="1"> <thead> <tr> <th>DATE</th> <th>DEPTH (TOG)</th> <th>ELEVATION</th> </tr> </thead> <tbody> <tr> <td>07-23-13</td> <td>10.7</td> <td>38.85</td> </tr> <tr> <td>08-28-13</td> <td>11.3</td> <td>38.25</td> </tr> </tbody> </table>	DATE	DEPTH (TOG)	ELEVATION	07-23-13	10.7	38.85	08-28-13	11.3	38.25		
DATE	DEPTH (TOG)	ELEVATION									
07-23-13	10.7	38.85									
08-28-13	11.3	38.25									
REMARKS:											

NOTES: 1. DIMENSIONS NOMINAL UNLESS OTHERWISE NOTED 2. TOG = TOP OF GROUND	DRILLED BY: MG	STARTED: 07-22-13	NORTHING: 13792624.95 EASTING: 3129627.27
	LOGGED BY: TM	COMPLETED: 07-22-13	GROUND LEVEL (MSL): 49.55 FT
	CHECKED BY: NK	APPROVED BY: MB	SHEET <u>1</u> OF <u>1</u>

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: MINNETEX AREA AND ALMEDA GENOA PLACE PAVING AND DRAINAGE IMPROVEMENTS WBS NO. M-000289-0002-3		PIEZOMETER NUMBER: GB-10P
GEOTECHNICAL CONSULTANT GEOTEST ENGINEERING, INC.	DESIGN CONSULTANT KIT PROFESSIONALS, INC.	HOUSTON, TEXAS

COMPLETION DATE <u>07-22-13</u> DRY AUGERED <u>0</u> TO <u>25.0</u> FT WASH BORED <u>---</u> TO <u>---</u> FT DRILLING FLUID: <u>WATER</u>			DEPTH (FT) ELEV. (FT) 0 46.27			
DEVELOPMENT DATE: <u>07-22-13</u> METHOD OF DEVELOPMENT: <u>BAILING</u>						
WATER LEVEL READINGS: DATE DEPTH (TOG) ELEVATION 07-23-13 17.3 28.97 08-28-13 10.8 35.47						
			(NOT TO SCALE)			
REMARKS:						

NOTES: 1. DIMENSIONS NOMINAL UNLESS OTHERWISE NOTED 2. TOG = TOP OF GROUND	DRILLED BY: MG	STARTED: 07-22-13	NORTHING: 13792237.08 EASTING: 3132292.75
	LOGGED BY: TM	COMPLETED: 07-22-13	GROUND LEVEL (MSL): 46.27 FT
	CHECKED BY: NK	APPROVED BY: MB	SHEET <u>1</u> OF <u>1</u>

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: MINNETEX AREA AND ALMEDA GENOA PLACE PAVING AND DRAINAGE IMPROVEMENTS WBS NO. M-000289-0002-3		PIEZOMETER NUMBER: GB-12P
GEOTECHNICAL CONSULTANT GEOTEST ENGINEERING, INC.	DESIGN CONSULTANT KIT PROFESSIONALS, INC.	HOUSTON, TEXAS

COMPLETION DATE <u>07-22-13</u> DRY AUGERED <u>0</u> TO <u>25.0</u> FT WASH BORED <u>--</u> TO <u>--</u> FT DRILLING FLUID: <u>WATER</u>	DEPTH (FT) ELEV. (FT) 0 47.67 2 45.67 5 42.67 15 32.67 25 22.67 25 22.67 25 22.67	
DEVELOPMENT DATE: <u>07-22-13</u> METHOD OF DEVELOPMENT: <u>BAILING</u>		
WATER LEVEL READINGS: DATE DEPTH (TOG) ELEVATION 07-23-13 DRY 08-28-13 17.3 30.37		
REMARKS:		

NOTES: 1. DIMENSIONS NOMINAL UNLESS OTHERWISE NOTED 2. TOG = TOP OF GROUND	DRILLED BY: MG	STARTED: 07-22-13	NORTHING: 13791581.62 EASTING: 3130684.67
	LOGGED BY: TM	COMPLETED: 07-22-13	GROUND LEVEL (MSL): 47.67 FT
	CHECKED BY: NK	APPROVED BY: MB	SHEET <u>1</u> OF <u>1</u>

PIEZOMETER INSTALLATION REPORT

PROJECT NAME: MINNETEX AREA AND ALMEDA GENOA PLACE PAVING AND DRAINAGE IMPROVEMENTS WBS NO. M-000289-0002-3		PIEZOMETER NUMBER: GB-17P
GEOTECHNICAL CONSULTANT GEOTEST ENGINEERING, INC.	DESIGN CONSULTANT KIT PROFESSIONALS, INC.	HOUSTON, TEXAS

COMPLETION DATE <u>07-22-13</u> DRY AUGERED <u>0</u> TO <u>22.0</u> FT WASH BORED <u>22.0</u> TO <u>31.0</u> FT DRILLING FLUID: <u>WATER</u>	DEPTH (FT) ELEV. (FT) 0 46.31 2 45.31 11 35.31 21 25.31 31 15.31 31 15.31 31 15.31	<p> TYPE OF BACKFILL <u>CEMENT-BENTONITE</u> RISER TYPE <u>PVC CASING</u> I.D. <u>2"</u> TYPE OF COUPLING <u>THREADED</u> TYPE OF SEAL <u>BENTONITE</u> TYPE OF FILTER <u>FILTER SAND</u> SCREEN TYPE <u>SLOT</u> I.D. <u>2"</u> SLOT SIZE <u>0.01"</u> TYPE OF BOTTOM CAP <u>THREADED PVC</u> </p> <p>2 FT 9 FT 10 FT 10 FT 0 FT 0 FT</p> <p>5.0"</p>									
DEVELOPMENT DATE: <u>07-22-13</u> METHOD OF DEVELOPMENT: <u>BAILING</u>	(NOT TO SCALE)										
WATER LEVEL READINGS: <table border="1"> <thead> <tr> <th>DATE</th> <th>DEPTH (TOG)</th> <th>ELEVATION</th> </tr> </thead> <tbody> <tr> <td>07-23-13</td> <td>16.1</td> <td>30.21</td> </tr> <tr> <td>08-28-13</td> <td>15.8</td> <td>30.51</td> </tr> </tbody> </table>			DATE	DEPTH (TOG)	ELEVATION	07-23-13	16.1	30.21	08-28-13	15.8	30.51
DATE	DEPTH (TOG)	ELEVATION									
07-23-13	16.1	30.21									
08-28-13	15.8	30.51									
REMARKS:											

NOTES: 1. DIMENSIONS NOMINAL UNLESS OTHERWISE NOTED 2. TOG = TOP OF GROUND	DRILLED BY: MG	STARTED: 07-22-13	NORTHING: 13793129.43 EASTING: 3131240.99
	LOGGED BY: TM	COMPLETED: 07-22-13	GROUND LEVEL (MSL): 46.31 FT
	CHECKED BY: NK	APPROVED BY: MB	SHEET <u>1</u> OF <u>1</u>

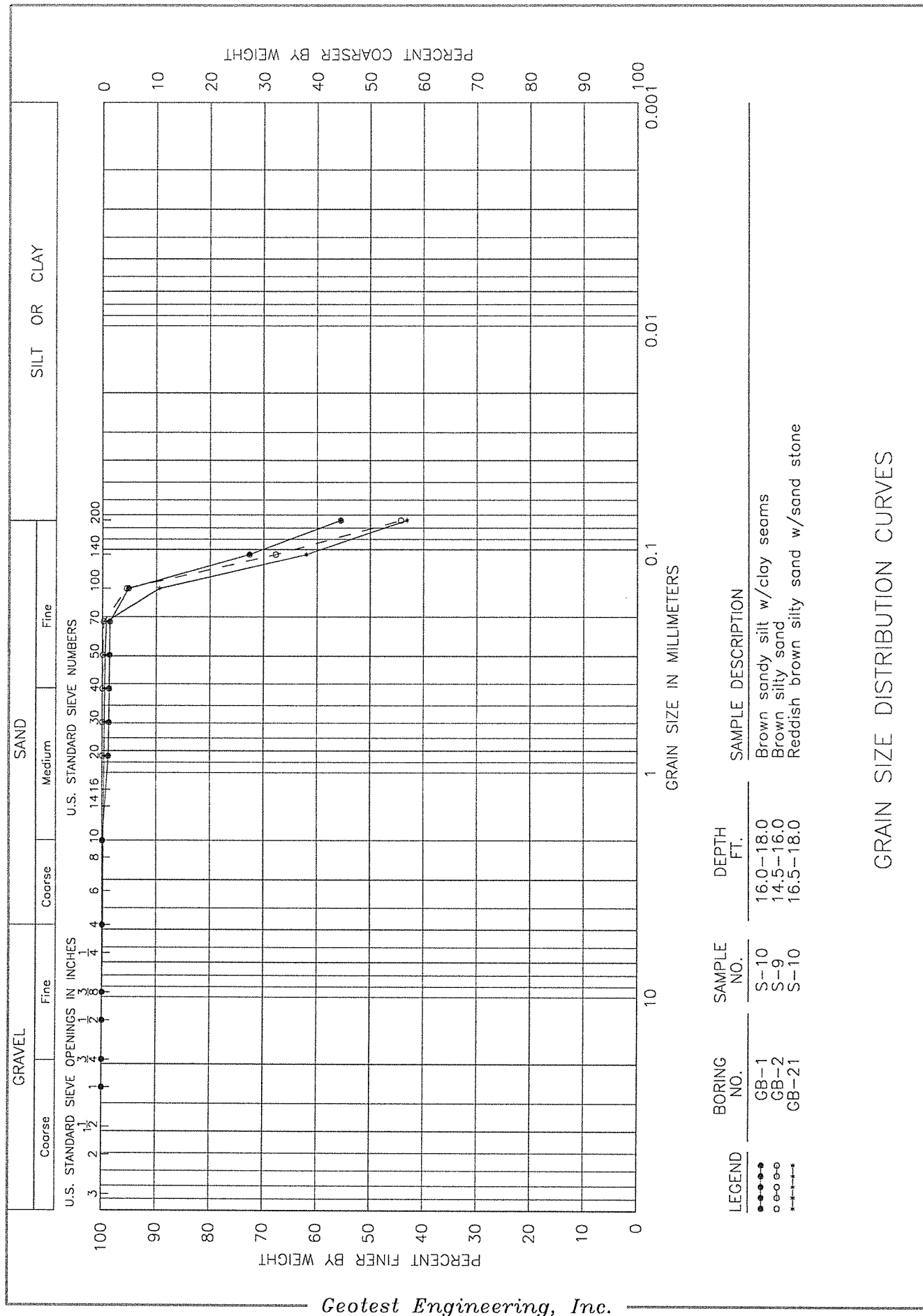
APPENDIX B

Figure

Summary of Laboratory Test Results	B-1 thru B-21
Grain Size Distribution Curves.....	B-22

[illegible]

FIGURE B-4



Geotest Engineering, Inc.

FIGURE B-22

APPENDIX C

Piezometer Abandonment Reports

STATE OF TEXAS WELL REPORT for Tracking #338184

Owner:	Minnetex Place Almeda	Owner Well #:	GB-1
Address:	8703 Brae Acres Rd Houston , TX 77074	Grid #:	65-22-7
Well Location:	8703 Brae Acres Rd Houston , TX 77074	Latitude:	29° 37' 35" N
Well County:	Harris	Longitude:	095° 20' 10" W
Elevation:	No Data	GPS Brand Used:	Magellan
Type of Work: New Well		Proposed Use: Monitor	

Drilling Date: Started: **7/22/2013**
Completed: **7/22/2013**

Diameter of Hole: Diameter: **2 in From Surface To 25 ft**

Drilling Method: **Mud Rotary Bored**

Borehole Completion: Gravel Packed From: **15 ft to 25 ft**
Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **No Data**
2nd Interval: **No Data**
3rd Interval: **No Data**

Surface Completion: **Alternative Procedure Used**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No Data**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Envirotech Drilling Services**
2718 South Brompton Drive
Pearland , TX 77584

Driller License Number: **58171**
Licensed Well Driller Signature: **Jaime Vasquez**
Registered Driller Apprentice Signature: **Mario Gonzalez**
Apprentice Registration Number: **No Data**
Comments: **No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #338184) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft)	To (ft)	Description
0-1	8"	SA Shell w/Cl
1-2	DK g	SA CL
2-8	g-Br	
8-10	Br	
10-11	RD-CL	
11-16	BR SA	
16-25	Br CL	

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2"	New	PVC Riser	0-15 sch.40
2"	New	PVC Screen	15-25 0.010

STATE OF TEXAS PLUGGING REPORT for Tracking #90480

Owner:	Geotest Engineering	Owner Well #:	GB-1
Address:	5600 Bintliff Houston , TX 77036	Grid #:	65-30-1
Well Location:	4529 Lincolnshire Houston , TX 77048	Latitude:	29° 37' 10" N
Well County:	Harris	Longitude:	095° 20' 45" W
		GPS Brand Used:	Magellan

Well Type: Monitor

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller: Mario Gonzalez

Driller's License Number of Original Well Driller: No Data

Date Well Drilled: 7/22/2013

Well Report Tracking Number: 338184

Diameter of Borehole: 4 inches

Total Depth of Borehole: 25' feet

Date Well Plugged: 10/14/2013

Person Actually Performing Plugging Operation: Mario Gonzalez

License Number of Plugging Operator: 58171

Plugging Method: Tremmie pipe cement from bottom to top.

Plugging Variance #: No Data

Casing Left Data: 1st Interval: No Data
2nd Interval: No Data
3rd Interval: No Data

Cement/Bentonite Plugs Placed in Well: 1st Interval: From 0 ft to 2 ft; Sack(s)/type of cement used: Concrete
2nd Interval: From 2 ft to 25 ft; Sack(s)/type of cement used: Grout/Cement
3rd Interval: No Data
4th Interval: No Data
5th Interval: No Data

Certification Data: The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: Envirotech Drilling Services
2718 S. Brompton Drive
Pearland , TX 77584

Plug Installer License Number: 58171

Licensed Plug Installer Signature: Jaime Vasquez

Registered Plug Installer Apprentice Signature: Mario Gonzalez

Apprentice Registration Number: No Data

Plugging Method Comments: Amended at request of driller. Unable to utilize amendment request functionality - 10/28/13 DT

Please include the plugging report's tracking number (Tracking #90480) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS WELL REPORT for Tracking #338173Owner: **Minnetex Place Almeda**Owner Well #: **GB-10**Address: **8703 Brae Acres Rd
Houston, TX 77074**Grid #: **65-22-7**Well Location: **8703 Brae Acres Rd
Houston, TX 77074**Latitude: **29° 37' 35" N**Well County: **Harris**Longitude: **095° 20' 10" W**Elevation: **No Data**GPS Brand Used: **Magellan**Type of Work: **New Well**Proposed Use: **Monitor**Drilling Started: **7/22/2013**Date: Completed: **7/22/2013**Diameter of Hole: **Diameter: 2 in From Surface To 25 ft**Drilling Method: **Mud Rotary Bored**Borehole Completion: **Gravel Packed From: 15 ft to 25 ft
Gravel Pack Size: 20/40**Annular Seal Data: **1st Interval: No Data****2nd Interval: No Data****3rd Interval: No Data**Surface Completion: **Alternative Procedure Used**Water Level: **Static level: No Data****Artesian flow: No Data**Packers: **No Data**Plugging Info: **Casing or Cement/Bentonite left in well: No Data**Type Of Pump: **No Data**

Well Tests: **No Data**

Water Type of Water: **No Data**

Quality: Depth of Strata: **No Data**

Chemical Analysis Made: **No Data**

Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company **Envirotech Drilling Services**
Information: **2718 South Brompton Drive**
Pearland , TX 77584

Driller **58171**

License
Number:

Licensed **Jaime Vasquez**
Well Driller
Signature:

Registered **Mario Gonzalez**
Driller
Apprentice
Signature:

Apprentice **No Data**
Registration
Number:

Comments: **No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #338173) on your written request.

Texas Department of Licensing & Regulation**P.O. Box 12157****Austin, TX 78711****(512) 463-7880****DESC. & COLOR OF FORMATION
MATERIAL****CASING, BLANK PIPE & WELL SCREEN
DATA**

From (ft) To (ft) Description**0-1.5 10" BI SA Asphalt g shell****1.5-2.5 DK g CL****2.5-8 y-g****8-12 RD****12-25 Br**

Dia. New/Used Type Setting From/To**2" New PVC Riser 0-15 sch.40****2" New PVC Screen 15-25 0.010**

STATE OF TEXAS PLUGGING REPORT for Tracking #90478

Owner:	Geotest Engineering	Owner Well #:	GB-10
Address:	5600 Bintliff Houston , TX 77036	Grid #:	65-30-1
Well Location:	4949 Glengarry Dr Houston , TX 77048	Latitude:	29° 37' 04" N
Well County:	Harris	Longitude:	095° 20' 16" W
		GPS Brand Used:	Magellan

Well Type: Monitor

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller: Mario Gonzalez

Driller's License Number of Original Well Driller: No Data

Date Well Drilled: 7/22/2013

Well Report Tracking Number: 338173

Diameter of Borehole: 4" inches

Total Depth of Borehole: 25' feet

Date Well Plugged: 10/14/2013

Person Actually Performing Plugging Operation: Mario Gonzalez

License Number of Plugging Operator: 58171

Plugging Method: Tremmie pipe cement from bottom to top.

Plugging Variance #: No Data

Casing Left Data: 1st Interval: No Data
2nd Interval: No Data
3rd Interval: No Data

Cement/Bentonite Plugs Placed in Well: 1st Interval: From 0 ft to 2 ft; Sack(s)/type of cement used: Concrete
2nd Interval: From 2 ft to 25 ft; Sack(s)/type of cement used: Grout/Cement
3rd Interval: No Data
4th Interval: No Data
5th Interval: No Data

Certification Data: The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: Envirotech Drilling Services
2718 S. Brompton Drive
Pearland , TX 77584

Plug Installer License Number: 58171

Licensed Plug Installer Signature: Jaime Vasquez

Registered Plug Installer Apprentice Signature: Mario Gonzalez

Apprentice Registration Number: No Data

Plugging Method Comments: Amended at request of driller. Unable to utilize amendment request functionality - 10/28/13 DT

Please include the plugging report's tracking number (Tracking #90478) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS WELL REPORT for Tracking #338180

Owner:	Minnetex Place Almeda	Owner Well #:	GB-12
Address:	8703 Brae Acres Rd Houston , TX 77074	Grid #:	65-22-7
Well Location:	8703 Brae Acres Rd Houston , TX 77074	Latitude:	29° 37' 35" N
Well County:	Harris	Longitude:	095° 20' 10" W
Elevation:	No Data	GPS Brand Used:	Magellan
Type of Work:	New Well	Proposed Use:	Monitor

Drilling Date: Started: **7/22/2013**
Completed: **7/22/2013**

Diameter of Hole: Diameter: **2 in From Surface To 25 ft**

Drilling Method: **Mud Rotary Bored**

Borehole Completion: Gravel Packed From: **15 ft to 25 ft**
Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **No Data**
2nd Interval: **No Data**
3rd Interval: **No Data**

Surface Completion: **Alternative Procedure Used**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No Data**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Envirotech Drilling Services**
2718 South Brompton Drive
Pearland , TX 77584

Driller License Number: **58171**
Licensed Well Driller Signature: **Jaime Vasquez**
Registered Driller Apprentice Signature: **Mario Gonzalez**
Apprentice Registration Number: **No Data**
Comments: **No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking number (Tracking #338180) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft)	To (ft)	Description
0-1	3"	SA Shell
1-2	DR g	SA CL
2-6	Br-g	
6-8	Si-Cl	
8-9	RD-CL	
9-25	Br	

CASING, BLANK PIPE & WELL SCREEN DATA

Dia.	New/Used	Type	Setting From/To
2"	New	PVC Riser	0-15 sch.40
2"	New	PVC Screen	15-25 0.010

STATE OF TEXAS PLUGGING REPORT for Tracking #90479

Owner:	Geotest Engineering	Owner Well #:	GB-12
Address:	5600 Bintliff Houston , TX 77036	Grid #:	65-30-1
Well Location:	4702 Allison Rd Houston , TX 77048	Latitude:	29° 36' 59" N
Well County:	Harris	Longitude:	095° 20' 34" W
		GPS Brand Used:	Magellan

Well Type: Monitor

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller: Mario Gonzalez

Driller's License Number of Original Well Driller: No Data

Date Well Drilled: 7/22/2013

Well Report Tracking Number: 338180

Diameter of Borehole: 4 inches

Total Depth of Borehole: 25' feet

Date Well Plugged: 10/14/2013

Person Actually Performing Plugging Operation: Mario Gonzalez

License Number of Plugging Operator: 58171

Plugging Method: Tremmie pipe cement from bottom to top.

Plugging Variance #: No Data

Casing Left Data: 1st Interval: No Data
2nd Interval: No Data
3rd Interval: No Data

Cement/Bentonite Plugs Placed in Well: 1st Interval: From 0 ft to 2 ft; Sack(s)/type of cement used: Concrete
2nd Interval: From 2 ft to 25 ft; Sack(s)/type of cement used: Grout/Cement
3rd Interval: No Data
4th Interval: No Data
5th Interval: No Data

Certification Data: The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: Envirotech Drilling Services
2718 S. Brompton Drive
Pearland , TX 77584

Plug Installer License Number: 58171

Licensed Plug Installer Signature: Jaime Vasquez

Registered Plug Installer Apprentice Signature: Mario Gonzalez

Apprentice Registration Number: No Data

Plugging Method Comments: Amended at request of driller. Unable to utilize amendment request functionality - 10/28/13 DT

Please include the plugging report's tracking number (Tracking #90479) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

STATE OF TEXAS WELL REPORT for Tracking #338193

Owner:	Minnetex Place Almeda	Owner Well #:	GB-17
Address:	8703 Brae Acres Rd Houston , TX 77074	Grid #:	65-22-7
Well Location:	8703 Brae Acres Rd Houston , TX 77074	Latitude:	29° 37' 35" N
Well County:	Harris	Longitude:	095° 20' 10" W
Elevation:	No Data	GPS Brand Used:	Magellan
Type of Work: New Well		Proposed Use: Monitor	

Drilling Date: Started: **7/22/2013**
Completed: **7/22/2013**

Diameter of Hole: Diameter: **2 in From Surface To 25 ft**

Drilling Method: **Mud Rotary Bored**

Borehole Completion: Gravel Packed From: **15 ft to 25 ft**
Gravel Pack Size: **20/40**

Annular Seal Data: 1st Interval: **No Data**
2nd Interval: **No Data**
3rd Interval: **No Data**

Surface Completion: **Alternative Procedure Used**

Water Level: Static level: **No Data**
Artesian flow: **No Data**

Packers: **No Data**

Plugging Info: Casing or Cement/Bentonite left in well: **No Data**

Type Of Pump: **No Data**

Well Tests: **No Data**

Water Quality: Type of Water: **No Data**
Depth of Strata: **No Data**
Chemical Analysis Made: **No Data**
Did the driller knowingly penetrate any strata which contained undesirable constituents: **No Data**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: **Envirotech Drilling Services
2718 South Brompton Drive
Pearland , TX 77584**

Driller License Number: **58171**
Licensed Well Driller Signature: **Jaime Vasquez**
Registered Driller Apprentice Signature: **Mario Gonzalez**
Apprentice Registration Number: **No Data**
Comments: **No Data**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Please include the report's Tracking number (Tracking #338193) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880

DESC. & COLOR OF FORMATION MATERIAL

From (ft) To (ft) Description
0-1 12" Br SA Shell DK g CL
1-8 Br-g-SA-CL
8-12 RD-CL
12-18.5 Br SA CL
18.5-22 RD-SI-CL
22-25 RD-CL

CASING, BLANK PIPE & WELL SCREEN DATA

Dia. New/Used Type Setting From/To
2" New PVC Riser 0-15 sch.40
2" New PVC Screen 15-25 0.010

STATE OF TEXAS PLUGGING REPORT for Tracking #90481

Owner:	Geotest Engineering	Owner Well #:	GB-17
Address:	5600 Binliff Houston , TX 77036	Grid #:	65-30-1
Well Location:	13018 Cottingham Houston , TX 77048	Latitude:	29° 37' 15" N
Well County:	Harris	Longitude:	095° 20' 27" W
		GPS Brand Used:	Magellan

Well Type: Monitor

HISTORICAL DATA ON WELL TO BE PLUGGED

Original Well Driller: Mario Gonzalez

Driller's License Number of Original Well Driller: No Data

Date Well Drilled: 7/22/2013

Well Report Tracking Number: 338193

Diameter of Borehole: 4 inches

Total Depth of Borehole: 25' feet

Date Well Plugged: 10/14/2013

Person Actually Performing Plugging Operation: Mario Gonzalez

License Number of Plugging Operator: 58171

Plugging Method: Tremmie pipe cement from bottom to top.

Plugging Variance #: No Data

Casing Left Data: 1st Interval: No Data
2nd Interval: No Data
3rd Interval: No Data

Cement/Bentonite Plugs Placed in Well: 1st Interval: From 0 ft to 2 ft; Sack(s)/type of cement used: Concrete
2nd Interval: From 2 ft to 25 ft; Sack(s)/type of cement used: Grout/Cement
3rd Interval: No Data
4th Interval: No Data
5th Interval: No Data

Certification Data: The plug installer certified that the plug installer plugged this well (or the well was plugged under the plug installer's direct supervision) and that each and all of the statements herein are true and correct. The plug installer understood that failure to complete the required items will result in the log(s) being returned for completion and resubmittal.

Company Information: Envirotech Drilling Services
2718 S. Brompton Drive
Pearland , TX 77584

Plug Installer License Number: 58171

Licensed Plug Installer Signature: Jaime Vasquez

Registered Plug Installer Apprentice Signature: Mario Gonzalez

Apprentice Registration Number: No Data

Plugging Method Comments: Amended at request of driller. Unable to utilize amendment request functionality - 10/28/13 DT

Please include the plugging report's tracking number (Tracking #90481) on your written request.

Texas Department of Licensing & Regulation
P.O. Box 12157
Austin, TX 78711
(512) 463-7880